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Quality Differentiation, Vertical Disintegration and The Labour Market Effects of Intra-Industry Trade

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In memoria di Nicla, un raggio di sole nella mia vita
A Gaetano, il futuro

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Summary

The work offers a new treatment of the labour market effects of international trade building on recent developments in the literature on intra-industry trade (IIT) stressing the importance of vertical IIT. The central idea is that heterogeneity of traded goods plays a crucial role both in terms of quality differentiation and vertical fragmentation of production. The basic concepts are presented in the introductory chapter. The second chapter presents an econometric study which shows that the role of factor intensity in IIT requires that different forms of IIT are properly distinguished. In the third chapter the evaluation of the impact of trade on labour markets is studied in a model in which IIT is explained on Heckscher-Ohlin principles. Applying the model to trade between Italy and less advanced countries and inferring the factor content of intra-industry trade from the inter-sectoral relationship between factor intensity and average unit values of exports, I find that the labour market effects of intra-industry trade add significantly to the estimated factor market impact of trade. Finally, fourth chapter is a study of Outward Processing Trade flows between the EU and Central Eastern European countries: results suggest that the labour market effects of intra-industry trade flows deriving from the vertical disintegration of production are significant.

Jel Codes:
Keywords

Chapter 1: Introduction

1.The significance of intra-industry trade and some open issues

Until the end of the fifties the prevailing paradigm of trade theory, namely the Heckscher-Ohlin (HO) model, was based on the view that the structure of foreign trade was dominated by inter-industry flows, that is exchanges of the products of distinct industries.

However at the beginning of the sixties early empirical studies on the effects of European integration on trade flows offered evidence of increasing intra-industry trade (IIT), that is to say exchanges of similar products of a given industry[1].

This phenomenon, apparently inexplicable in terms of the traditional trade theory based on comparative advantage, was gradually investigated through systematic empirical studies on the extension and characteristics of IIT[2]. The book by Grubel and Lloyd (1975) on the significance and measurement of IIT opened up a substantial literature.

Although some authors had even considered IIT as a statistical artefact (Finger, 1975), the majority of the scholars on the subject agreed on the relevance of IIT remarking some stylised facts: i) IIT is more extensive among advanced countries, ii) IIT is more pervasive in manufactures than in non-manufactures, iii) economic integration promotes intra-industry specialisation, as the rapid post-war growth of IIT in EU countries testifies.

Formally, intra-industry trade in country *j* is measured using the Grubel-Lloyd index:

$$IIT_j = 1 - \frac{\sum_i |X_i - M_i|}{\sum_i (X_i + M_i)} = \frac{\sum_i (X_i + M_i) - \sum_i |X_i - M_i|}{\sum_i (X_i + M_i)} \tag{1}$$

where *X* and *M* indicate the value of sectoral exports and imports respectively and the summations are over all sectors *i* in country *j*. The index calculates the average degree of overlap between exports and imports in the same industries in proportion to total trade. The term $\sum_i (X_i + M_i)$ is total trade and the term $\sum_i |X_i - M_i|$ is the value of non-overlap trade. Intra-industry trade is the value of total trade remaining after the subtraction of non overlap trade. When all total trade is non-overlap trade (so either X_i or M_i are zero in each sector), $IIT_j = 0$; in the absence of non-overlap trade (when X_i and M_i are equal in each sector), $IIT_j = 1$. Between these extremes, a higher value of IIT_j signals a greater level of intra-industry trade.

In the seventies and eighties a great number of studies on ITT were produced with particular interest in the important methodological issue of the correct measurement of the phenomenon. Specifically, trade economists debated whether the IIT index of should be adjusted for aggregate payments imbalance and categorical aggregation[3].

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[1]Verdoorn (1960), Balassa (1963).
[2]See, *inter alia*, Balassa (1966), Balassa (1967).
[3]On these important methodological questions see Aquino (1978, 1981), Greenaway and Milner (1981), Pomfret (1985).

In the presence of imbalance in the country's total trade, for example, the index (1) is biased downward as a measure of IIT given that, even in the case of intra-industry specialisation in all industries, exports cannot match imports in every industry. Suppose that in every industry exports exceed imports by 10%: although there is intra-industry trade in all sectors, the index is less than one.

The problem of categorical aggregation is that the IIT index is clearly sensitive to the choice of the grouping of products in a particular classification and the level of disaggregation. Various types of adjustment have been suggested but no conclusive solution has been reached about the correct measurement of IIT.

Notwithstanding these measurement problems, empirical work has gone ahead with econometric analysis of the determinants of IIT which have provided strong evidence of country-specific effects: i) IIT is higher in advanced countries than in less developed countries, ii) IIT is higher in large countries than small ones, iii) IIT is larger when there is taste overlap between trading countries[4].

These results are in line with the Drèze-Linder hypothesis according to which the opportunities for product differentiation and economies of scale depend on the extension of the internal market and if the demand for the product exists. Only when domestic market is developed on the basis of such demand, then international trade can be activated. This is especially likely between countries with similar demand structures (that is similar per capita income levels if they are good proxies for demand patterns)[5].

The analyses of Drèze and Linder in the early sixties on the determinants of international trade provided the initial elements for an alternative view to the HO paradigm. But it was Grubel and Lloyd's book, in the decade after its publication in 1975, which provided the catalyst for the modelling of IIT in terms of imperfect competition. In contrast with the traditional theory of inter-industry trade based on the single prevailing HO model, the theory of IIT embraces a range of different models where the diversity is due to the specific role played by the key variables of imperfect competition: notably types of market structure, types of product differentiation and scale economies.[6]

However, econometric tests of industry-specific determinants of IIT have provided less robust results than country-specific determinants, given the difficulties associated with the choice of the proxies for market structure variables (competition level, product differentiation and economies of scale) and the specification problems due to the diversity of theoretical models of IIT to test. The study of industry-specific determinants of IIT is a research field which needs to be explored more accurately. This work provides an attempt in this direction by focussing on the explanation of IIT in vertically differentiated products based on Heckscher-Ohlin principles.

Another important open and underexplored issue about IIT is the adjustment question.

Usually, less painful adjustment effects are ascribed to IIT in comparison with inter-industry trade: if products losing market share to import competition and products gaining export markets have similar factor intensities (and are produced in the same sectors), resource reallocation between them will be smoother, and wage and price adjustment will be minor. On political grounds, the idea of painlessness associated with IIT has been seen as the explanation for the wide acceptance of European integration, given that the main part of the growth of intra-European trade is IIT.

However, the analysis of the difference in adjustment costs between IIT and inter-sectoral trade has been little treated in the formal literature. One of the few attempts to model the proposition that IIT adjustment effects on domestic economy are less severe than inter-industry trade has been provided by Krugman (1981). In Krugman's framework, the supply side is modelled with a national economy consisting of two industries, each

[4]See Greenaway and Milner (1989) for a survey on econometric tests on IIT.
[5]Drèze (1961), Linder (1961).
[6]A survey of models of IIT is in Williamson and Milner (1991)

employing a specific type of labour (which is non-specific among varieties within an industry). By means of a very simple and compact formulation, Krugman shows the existence of a one-for-one positive relationship between the parameter indicating factor endowment similarity (among countries) and the Grubel-Lloyd IIT index. Subsequently, he analyzes the effect of trade on welfare by using an utility function in which utility depends on real wages and variety. Krugman demonstrates that both factors gain from trade when trading partners are similar in factor endowments and consequently IIT prevails over inter-industry trade. However, as shown later in this work, this kind of result does not obviously carry over to the case of IIT in vertically differentiated products.

2. Horizontal and vertical intra-industry trade

In recent years, important developments in the literature on intra-industry trade have also stressed that a meaningful distinction - alongside the main division between intra and inter-industry flows - can be drawn between horizontal and vertical components in IIT. This distinction is with regard to the nature of product differentiation. Whereas horizontal differentiation concerns alternative attributes of a particular traded good in a given quality level, vertical differentiation relates to alternative quality levels.

This conceptual specification is important because theoretical models have demonstrated that the forces underlying the two forms of product differentiation within IIT are not the same. Broadly speaking, in the case of vertical IIT (VIIT), the dynamics of product differentiation (by quality) operate according to a Heckscher-Ohlin (HO) logic based on comparative advantages deriving from resource endowments and factor proportions (although there are some non-HO models); in the case of horizontal IIT (HIIT), the typical ingredients of imperfectly competitive market structures play the dominant role.

In spite of these clear indications of the theory, in almost all cases empirical studies investigating the determinants of IIT have not distinguished vertical from horizontal intra-industry trade. Only in recent years have some contributions tried to achieve better empirical assessment by adopting methodological procedures able to separate the vertical and horizontal components of IIT.

Although the purpose of this recent empirical work has been to gain a clearer understanding of the determinants of IIT, the distinction between vertical and horizontal differentiation in intra-industry trade indirectly yields better specification of the problem of international-trade-induced adjustment as well. This work offers a new treatment of the labour market effects of international trade building on these recent developments in the literature on IIT which stress the importance of vertical IIT. The basic idea is that the impact of vertical IIT on labour markets in terms of factor substitution is not neutral, given that differences in quality of a product are associated with differences in skill intensity.

3. Separating horizontal and vertical intra-industry trade

Two approaches have been developed in the recent literature to tackle the issue of how to discriminate between the two types of IIT in empirical data. Both of them use unit values (UVs), the ratio of the value to the weight of a product being traded, as proxies for prices and consequently as the key indicator of quality differences. In the literature, the controversial aspects of employing UVs as substitutes for prices are well-known. The unit values of goods in the same product categories can vary because they are different types of products rather than two versions of the same product type. But if UVs are computed on disaggregated data at the product level the risk of distortions caused by aggregation is reduced and one can have more confidence that unit value differences genuinely reflect quality differences in otherwise similar products.

The first method of separating HIIT and VIIT is associated with the works of Abd-el-Rahman (1984), Freudenberg and Muller (1992) and CEPII (1995). This method is not based on the Grubel-Lloyd index. It instead adopts a minimum threshold of overlap in trade (10%) to establish whether both exports and imports of a particular product represent either two-way trade or one-way trade. In addition, assuming that differences in unit values signal quality differences, traded goods are defined as vertically (horizontally) differentiated if unit values of exports and imports differ by more (less) than a certain range of variation (±15%). When applied to each product**,** these two criteria (defined at the most disaggregated level) allow total trade to be divided into three categories: (i) two-way trade in vertically differentiated products (overlap and high unit value differences); (ii) two-way trade in horizontally differentiated products (overlap and low unit value differences); (iii) one-way trade (low overlap).

The second method is that of Greenaway, Hine and Milner (1994, 1995, hereafter GHM). These authors - following the work of Abd-el-Rahman (1991) - decompose the unadjusted Grubel-Lloyd (GL) index into vertical and horizontal IIT by using information deriving from unit values calculated at the 5 digit level of the Standard International Trade Classification (SITC). The two components of IIT are separated by including in the numerator of the GL index only the trade flows of those product categories whose unit value of exports relative to the unit value of imports is outside (or within) a certain range of variation (±15%). Where the absolute value of the difference between the unit values for exports and imports is more (less) than 15%, the share of vertical (horizontal) IIT is obtained.

In sum, both approaches use unit values in conjunction with an arbitrary dispersion criterion to infer the nature of product differentiation in IIT. But at the same time they adopt two different notions of trade overlap. In the first case, independently of the *extent* of the overlap, exports and imports are both considered to be part of either two-way trade or one-way trade, according to the 10% threshold criterion. In the second case, following the GL tradition, the *intensity* of trade overlap is measured.

In practice, the first method is mainly concerned with drawing the relevant demarcation line between *trade types*, rather than within the majority flow (as in the GL indicator). As stressed by the authors, this approach avoids the ambiguity that arises from considering the majority flow as simultaneously intra and inter in nature.[7] It also admits the possibility of recording a surplus or a deficit in the case of IIT as well, contrary to the GL index. Obviously, it cannot answer the specific question of the degree of overlap in trade. Furthermore, the first method adds a further element of arbitrariness represented by the choice of overlap threshold to the dispersion criterion for product differentiation.

The basic methodology adopted in the present work derives from the GHM approach.

4. The measurement of horizontal and vertical intra-industry trade

Equation (1) refers to the most common employment of the GL index where the *IIT* is computed for the country *j* across industries *i.* With data at a lower level of disaggregation, alternative measurements are possible. With product level trade data,

[7]Assume that the majority flow is 200 and the minority flow 100. The GL index calculates the overlap (100+100) in total trade (300); therefore it is equal to 66%. Evidently, according to the GL method, the majority flow is both intra and inter in nature. The alternative method, given that the minimum threshold of overlap (10%) is attained, would consider both flows (200+100) to be intra in nature.

equation (1) could describe the IIT index in sector *j* (in a particular country) where the summations were over all products *i* in sector *j*. In this case, the IIT index could be divided into its horizontal and vertical components:

$$HIIT_j = \frac{\sum_{i\in H}(X_i + M_i) - \sum_{i\in H}\left|X_i - M_i\right|}{\sum_i (X_i + M_i)} \tag{2}$$

where the summation i∈H in the numerator is over those commodities for which

$$1-\alpha \leq \frac{UV_i^x}{UV_i^m} \leq 1+\alpha\,; \tag{3}$$

and

$$VIIT_j = \frac{\sum_{i\in V}(X_i + M_i) - \sum_{i\in V}\left|X_i - M_i\right|}{\sum_i (X_i + M_i)} \tag{4}$$

where the summation i∈V is over those commodities for which

$$\frac{UV_i^x}{UV_i^m} \leq 1-\alpha \quad \text{or} \quad \frac{UV_i^x}{UV_i^m} \geq 1+\alpha \tag{5}$$

where the UV_i are the unit values of exports (*x*) and imports (*m*). Since the sets V and H are mutually exclusive and exhaustive, it follows immediately that

$$IIT_j = HIIT_j + VIIT_j \tag{6}$$

The above formulae are spelled out explicitly because there is an apparent notational error in the formulae presented in the Greenaway *et al.* papers (the summation in the denominator is over iεH or iεV respectively, rather than over all i).

5. Separating up-market and down-market vertical intra-industry trade

On the basis of the methodology illustrated above, GHM (1995) and Greenaway, Milner and Elliot (1996, GME) have carried out separate econometric tests for the two components of IIT in the case of the UK, focusing on a range of industry and country determinants of IIT. Overall, the work of Greenaway et al. suggests that the approach which distinguishes vertical from horizontal IIT is worth pursuing, given that it enables more accurate interpretation of empirical evidence. In particular, their results challenge the idea that the large numbers model of horizontal IIT is the most important explanatory paradigm. However, the evidence reported for the two components of IIT in the case of the UK is not decisive, since it depends closely on the source of data and their level of disaggregation, as well as the methodological criteria adopted.

The second chapter of this work takes GHM's methodology as its starting point to conduct further exploration of horizontal and vertical IIT in the UK (in 1990). With respect to the GHM approach, two novel characteristics are introduced in the analysis. The first is that unit values are computed at the 8-digit level of product disaggregation in order to eliminate problems of sectoral composition. The second one concerns the relationship between vertical IIT and the skill-intensity of production. The interpretation of this relationship is improved when vertical IIT is further divided into two components which are separately tested: "up-market" VIIT where the unit values of the export flow is greater (by at least 15%) than the import unit values; and "down-market" VIIT where it is import unit values that are larger. The second chapter shows that when the two different forms of vertical IIT are properly distinguished, the role of factor intensity in IIT emerges more clearly, supporting an explanation of vertical IIT based on Heckscher-Ohlin principles.

6. The labour markets effects of intra-industry trade in the presence of quality differentiation

The focus of the third chapter is on the labour market effects of international trade which are studied in a model in which IIT is explained on Heckscher-Ohlin principles.

The impact of international trade on the labour market is a topic of growing interest among economists. In the last two decades, income distribution has changed greatly in the USA, with a widening gap between the wages of skilled and unskilled workers. Although West European countries have not shown such a dramatic change in income differentials (with the exception of the UK), they have exhibited high rates of unemployment, especially among less skilled workers. This empirical finding has raised the question of whether the unfavourable pressure on lower-skilled labour forces in developed economies can be ascribed to the increasing competitiveness of low cost countries or to technological innovation.

The discussion still continues, and disputes now centre on the analytical framework as well as empirical results in this field. The emphasis has recently shifted to wage inequality as resulting from skill-biased technological change, on the basis of a widely accepted lack of evidence that trade can explain the relative demand function shift during the 1980s[8].

One way to deal with the relative effects on the labour markets of trade versus technological change is to measure the so-called 'between/within effect' with reference to industries[9]. The trade effect has quite often been associated with a small employment reallocation impact because the 'between' effect has been minor compared with the 'within' effect. However product heterogeneity may play a crucial role in this result.

For instance, in the 'between/within' decomposition[10] of the rise in the share of white-collar workers, aggregating industries increases the relative importance of the 'within' component of the decomposition, especially when there are large differences in labour utilization within industries. The 'within' component may hide compositional demand effects due to heterogeneity which in a more disaggregated evaluation would result in a much greater 'between effect'.[11] This is not identifiable with an empirical aggregate evaluation. Hence, whenever sectors are the units of analysis, problems of heterogeneity may hide important effects.

Which perspective can assist the consideration of these hidden effects? It may help to consider trade among countries with different endowments of human skills as inducing or changing movements along the quality spectrum for each sector. In other words, trade induces factor substitution *within* sectors at the level of individual products where the relevant factors are human capital, knowledge, immaterial and specific factors. Thus, trade impact is intra-sectoral and is not neutral on the international division of labour, as shown by the vertical differentiation of trade flows.

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[8] See the recent symposium in *The Journal of Economic Perspectives*, Spring 1997

[9] A standard decomposition of the change, for example, in aggregate white collar employment divides the aggregate into two terms. The first term shows the change in the aggregate proportion of white collars attributable to shifts in employment shares between industries with different proportions of white collars. The second term reports the change in the aggregate proportion attributable to change in the proportion of white collars within each industry.

[10] see Berman *et al*. (1994)

[11] For instance, in Berman *et al*. (1994) the between effect explains 39 % of the shift in employment share at the four digit level and 15% only at two digit level.

In the third chapter this new perspective of analysis is implemented in order to re-evaluate the role of international trade in the adverse shift of relative demand for unskilled labour occurring in the developed countries. The model here presented, in which intra-industry trade is explained on Heckscher-Ohlin principles, turns out to be more consistent with the stylised facts about North-South trade than the traditional Heckscher-Ohlin model of inter-industry trade.

Empirically, the model is applied to trade between Italy and less advanced countries. Initially the computation of IIT indices, according to the methodology above described, has been carried out in order to identify the share of trade flows that are likely to have an impact on labour markets. These flows are inter-industry, inter-product and vertically differentiated flows. Then the evaluation of labour market effects of trade has been conducted through a novel methodology inferring the factor content of IIT from the inter-sectoral relationship between factor intensity and average unit values of exports. This method permits an estimation of the impact of two forms of non-competing trade in IIT: inter-product trade and vertical IIT. Results suggests that labour market effects of IIT add significantly to the estimated factor market impact of trade.

7.Vertical disintegration and the impact of intra-industry trade on labour markets

In the debate on “Trade and jobs”, recent contributions have also stressed the importance of outsourcing in the displacement of unskilled labour demand occurring in the developed countries in recent years[12]. The idea is that trade flows activated by processes of fragmentation of production on an international scale could have the same within-industry effects as technological change on the unskilled-adverse shift in labour demand. Therefore an evaluation of trade impact only confined to inter-industry trade flows would underestimate the labour market effects of vertical disintegration of production as well as the effects of quality differentiation. For this reason, the fourth chapter focuses on an example of international fragmentation of production, the case of Outward Processing Trade (OPT) between the EU and Central Eastern European countries (CEEC).

The study of OPT may offer an interesting analytical perspective because it gives us data on a particular form of vertical disintegration and also because OPT is an important part of EU-CEEC trade and trade relationships between EU and CEECs raise important policy issues.

Firstly, the fourth chapter gives a general overview of OPT flows showing that they have grown at a higher pace than final flows in the last decade, confirming the increasing importance of vertical flows in world trade, as mentioned in recent studies[13]. In addition, OPT data indicates a straightforward international division of labour given that the concentration of OPT in a few sectors links up with a strong geographical specialisation. In particular, OPT flows in the textile-apparel sector are almost entirely channelled to CEECs.

The fourth chapter focuses on textile-clothing-footwear-leather sectors where the EU-CEEC OPT flows are of comparable size to final flows. Two EU countries are investigated, Germany and Italy, because of their importance in total EU-CEEC OPT flows and because they embody two different models of outsourcing towards CEECs.

[12]See, *inter alia*, Feenstra (1998).
[13]Hummels, Rapoport, Kei-Mu Yi (1998), Feenstra (1998).

The factor content of trade (FCT) analysis conducted at both levels of inter-industry trade and intra-industry trade signals a more significant impact of OPT flows than final flows on labour markets of EU countries.

Although the methodology aiming to estimate factor content of IIT suffers from some limitations when applied to OPT flows, nevertheless the analysis of trade-induced adjustment at the intra-sectoral level may provide a better understanding of eventual resistances to trade liberalisation processes in the EU especially in “sensitive” sectors. In other words, the evaluation of labour market effects of EU IIT with CEECs is important since eventual trade-induced strains on EU labour markets might influence the stance of trade policies towards CEECs and the timing of EU enlargement to CEECs.

8. Conclusions

In summary, this work focuses on the explanation of IIT within the Heckscher-Ohlin approach to international trade and provides new analysis of two controversial issues emerging in the literature on IIT: the econometric specification of industry-specific determinants of IIT and the adjustment effects associated with IIT.

With regard to the first question, the second chapter offers new evidence on horizontal and vertical IIT in the case of the UK. Specifically, the econometric analysis of the factors generating vertical IIT is improved when vertical IIT is further divided into its up-market and down-market components. In this case, VIIT is better explained on HO principles with the role of factor proportion emerging more clearly and indicating the direction of comparative advantages. The econometric study reported in the present work is not conclusive and the robustness of the results needs to be tested by extending the analysis of the UK IIT to other geographical groupings, especially in the light of the theory of factor proportion, according to which differences in factor endowments between trade partners are crucial. Notwithstanding these limitations, also dictated by the need for economy of research, the analysis reported in the present work indicates a new perspective to be pursued.

With reference to the second issue, the third chapter provides a new treatment of the labour market effects of IIT. On the one hand, the analysis of the third chapter is built on and closely connected to the previous one: while the second chapter enquires into the effects of factor proportion on IIT, here the effects of IIT on factor markets are investigated. On the other hand, the third chapter can be seen as an autonomous contribution to the debate on “Trade and jobs”.

Built on a model of VIIT based on Heckscher-Ohlin assumptions, the analysis of the third chapter warns against the risk of understating the impact of trade on labour markets if product heterogeneity is not adequately considered. The results of a new methodological approach suggests that the labour market effects of IIT, in terms of inter-product flows and vertically differentiated intra-product flows, are relevant. The robustness of that new approach needs further exploration. However, sensitivity analysis of the results offers encouraging support for the consistency of the numbers obtained. Nevertheless, the agenda for future research should consider other case studies and a less crude treatment of the skill content of production, here proxied by the distinction between manual and non-manual labour.

The final chapter introduces the dimension of vertical disintegration of production in IIT. The analysis focuses on Outward Processing Trade (OPT) between the EU and Central Eastern European Countries (CEEC). The methodology used to estimate the factor content of IIT in final flows is now applied to OPT flows. Results suggests that the impact of OPT on EU labour markets is greater than that of final flows. However the results have to be interpreted very carefully in the case of OPT flows, given that the FCT method of calculation at the product level is more suitable for final goods and to capture quality differentiation than vertical disintegration. Future research should employ a more appropriate methodology to estimate the factor content of ITT in a context in which trade flows are of different nature in comparison with final flows. The study of OPT effects on labour markets is here confined to the case of Italian and German trade with CEECs in textile-clothing sectors and further research needs to be carried out to test these results for other industries and other countries.

Chapter 2: Empirical explanation of vertical intra-industry trade in the UK

1. Introduction

The introductory chapter defined the concepts of vertical and horizontal intra-industry trade and showed that the theoretical underpinnings of the two kinds of IIT are distinct: HIIT being explained by imperfectly competitive markets, VIIT largely by resource endowments and factor proportions.

In spite of this theoretical distinction, almost all empirical studies investigating the determinants of IIT have not distinguished vertical from horizontal intra-industry trade. Only in recent years have some contributions tried to achieve better empirical assessment by adopting methodological procedures able to disentangle vertical and horizontal components in IIT.

Greenaway, Hine and Milner (1994, 1995) and Greenaway, Milner and Elliott (1996) have built on the work of Abd-el-Rahman (1991) to measure HIIT and VIIT in the UK's trade with the EU and to analyse the different forces underlying the two types of IIT by regression analysis.

Greenaway, Hine and Milner (1994, 1995; henceforth GHM) used unit value data to distinguish between VIIT and HIIT and carried out separate econometric tests for the two components of IIT in the case of the UK, focusing on a range of industry and country determinants of IIT. According to GHM, discriminating between vertical and horizontal IIT improves the interpretation of empirical results. Nevertheless, the evidence reported for the two components of IIT in the case of the UK is not conclusive, since it may depend closely on the source of the data, the level of disaggregation of products, and the criteria adopted to distinguish the two forms of intra-industry trade.

This chapter takes GHM's methodology as its starting point to conduct further investigation of horizontal and vertical IIT in the UK, using 1990 data. It introduces two innovative features compared to the GHM approach. Firstly, unit values are computed using trade data at a very fine level of product disaggregation, 8-digit as compared to the 5-digit level adopted by GHM, in order to obtain a more reliable proxy for prices and consequently for quality differentiation. Secondly, the share of vertical differentiation in IIT is further divided into two components which are separately tested: the part of vertical IIT composed of flows in which the quality of exports appears higher than the quality of imports; and the remaining part consisting of flows in which exports appear to be of lower quality than imports. As shown below, this further distinction yields a more coherent specification of the expected relationship between quality differentiation and vertical intra-industry trade, though there remain unanswered questions about the explanation of intra-industry trade.

The chapter is organized as follows. The next section discusses the difference between horizontal and vertical product differentiation, conducting a brief survey of the relevant theoretical literature on IIT. Section 3 examines results obtained by Greenaway *et al*. whose work represents the state of the art of the empirical investigation into horizontal and vertical IIT. Section 4 introduces the two types of vertical IIT and presents an econometric test for the industry-specific determinants of the IIT in the UK, giving details on data, definition of variables, statistical specification and results. The final section makes some concluding remarks.

2. Horizontal and vertical product differentiation in intra-industry trade

2.1 The Dixit-Stiglitz-Krugman model

Initially, both theoretical explanations of IIT, such as Dixit and Stiglitz (1977) and Lancaster (1979), and empirical investigations, such as Balassa and Bauwens (1987), focused on what has become known as horizontal intra-industry trade (HIIT) - simultaneous export and import of products of the same type and similar quality. The focus both in the theoretical and the empirical work is on the explanation of IIT through the functioning of imperfectly competitive markets in differentiated products.

By extending Dixit and Stiglitz's (1977) closed economy model to the international context, Paul Krugman (1979) demonstrates that the interaction between economies of scale and horizontal product differentiation may be an independent cause of international trade (in the form of IIT) between countries which do not differ in technology or factor endowments.

The Dixit-Stiglitz-Krugman model has dominated the subsequent literature. The assumptions of Krugman's model are straightforward. On the supply side, industry consists of a large number of firms, each producing a particular variety of the product under conditions of increasing returns. On the demand side, individuals appreciate variety in itself, and any new differentiated good available in the market is bound to enter the consumer's basket. In autarky, in each country, the range of varieties available to consumers and the exploitation of economies of scale are both constrained by the size of the market. International trade will improve the trade-off between variety and scale economies by creating a larger integrated market in which intra-industry specialization between countries may enable firms to reduce unit costs (although in the simplest version of Krugman's model, all firms are of the same size and there are no scale economy benefits from increases in market size), and in which access to a larger number of varieties increases consumer welfare

The most obvious candidates for the horizontal IIT described by Krugman's model are countries with similar factor endowments and similar (high) income levels, and in such models there may also be an association between demand structure and income level (Linder, 1961) so that countries similar in income level will tend to have more trade between them.

2.2 Modelling vertical intra-industry trade

However, Falvey (1981) and Falvey and Kierzkowski (1985) (henceforth FK) presented a model in which intra-industry trade was driven by vertical product differentiation, and imports and exports of products within the same commodity classification are distinguished by quality differences. This is vertical intra-industry trade (VIIT). By contrast with the models of horizontal IIT, this is a model which is firmly in the Heckscher-Ohlin tradition in which countries have common tastes and technology, and trade arises from differences in factor endowments of countries and factor requirements of goods. Like the standard Heckscher-Ohlin, the FK model can be adapted to include technological differences between countries. The model differs from the standard textbook HOS model in that factor endowment differences explain intra-sectoral rather than inter-sectoral specialisation: it is a Heckscher-Ohlin model of intra-industry trade.

In FK, the supply side of each economy is modelled as two sectors, one producing a single homogeneous good and the other manufacturing different qualities of the same product. Both sectors employ labour, while capital is used only in the sector producing the multi-quality product, with capital intensity positively correlated with the "quality intensity" of the differentiated product. On the demand side, consumers have the same preferences, and the demand for each quality, given relative prices, depends on an individual's income: a higher level of income is associated with demand for a higher quality product. On the reasonable assumption of an uneven distribution of aggregate income among consumers, demand for different qualities of product will emerge in the economy, and the range of qualities demanded will depend on income distribution.

Under these assumptions, the actual pattern of trade - with particular reference to the extent and character of vertical intra-industry trade - depends on the relative influence of the three sources of country differences: factor endowments, technology, and income distribution.

The spectrum of relevant cases presented by FK is very broad, and in some circumstances the outcomes are indeterminate. However, in the present context, two main results are worth recalling: one deriving from HO assumptions and the other arising from Ricardian hypotheses.

i) Assuming identical technologies but different factor endowments, the pattern of inter-industry trade is clearly determined: the capital-abundant country will be an importer of the homogeneous good and a net exporter of the differentiated product. In this setting, vertical IIT may or may not take place. Moreover, even if IIT occurs, the pattern of IIT in terms of the quality of traded goods is indeterminate. Although the capital-abundant country has a comparative advantage in superior quality production, this advantage may or may not be reflected in its exports. Paradoxically, if differences in factor endowments between the two countries are so pronounced as to determine large differences in their levels of per capita income, the abundant-capital country (the rich country) may concentrate its exports in lower quality products. In fact, a greater distance between the means of the two countries' equally shaped income distributions reduces their area of overlap, and the poor country will demand low quality products only. Obviously, different results are associated with different assumptions about the form of income distributions in the two countries.

ii) Assuming identical factor endowments but different technologies, the pattern of vertical IIT is determinate: the country with superior technology in the homogeneous good sector will tend to export high quality products and to import low quality goods.[14] In this case, with equal per capita income levels between trading partners, (which implies that the country with superior technology in one sector must have inferior technology in the other) consumers in both countries will divide into two groups: a group of high income individuals buying high quality products from the superior technology country, and a group of low income consumers demanding low quality products from the inferior technology country. These results show the way the FK model of vertical IIT combines the Linder-type idea of the importance of the link between demand structure and income with the traditional sources of comparative advantages.

They also show that the distinction between horizontal and vertical IIT is of more than academic interest. As was discussed in the introductory chapter, intra-industry trade is often assumed to give rise to less painful adjustment effects than inter-industry trade, and this idea has been formalised by Krugman (1981). When similar products with similar factor intensities and from the same industry are exchanged, the factors whose employment is displaced by imports are virtually the same as those whose employment is created by exports. The fact that so much of the growth of intra-European trade is IIT is seen as the explanation for the wide political acceptance of European integration. That is a story which assumes that IIT is horizontal.

But in respect of the adjustment problem, the implications of the FK model are clearly different from those of horizontal IIT models. Unlike horizontal diversification, vertical

[14]In fact, in a context of non equalization of factor prices, the higher wage rate of the technologically advanced country will involve a lower capital rental, giving this country a comparative advantage in higher quality products.

product differentiation requires different factor intensities. Consequently, the vertical specialization induced by international trade will imply more serious allocating and distributional effects than those of horizontal IIT. In the next chapter the labour market effects of VIIT will be explicitly treated.

Although the FK model treats the ratio of physical capital to labour as the determinant of the quality of output, Greenaway and Milner (1986) suggested that human capital is more likely to influence output quality than physical capital. Torstensson (1991, 1996) relates the quality of imports (measured by unit values) from partner countries to their endowments of both physical and human capital. (The next chapter will present a model of vertical intra-industry trade in which it is the ratio of skilled to unskilled labour that determines quality specialisation.)

In the FK model tastes for quality are related to income, so income differences between countries can also give rise to trade. In the empirical work in this chapter, however, we focus on the relationship between factor endowments and the supply of quality, and ignore the link between consumer income and the demand for quality.

2.3 The Shaked-Sutton model

An alternative way to deal with vertical differentiation in IIT has been suggested by Shaked and Sutton (1984, henceforth SS). Unlike FK, SS do not examine the interplay between vertical IIT and factor proportions but propose a framework in which attention concentrates mainly on the sensitivity of results to the specification of consumer preferences, in the tradition of product differentiation theory. In particular, they suggest an oligopolistic context in which the opening up of trade is associated with sharper price competition which forces some firms (producing low-quality goods) to abandon the market.

The focus of the SS analysis is on the conditions under which the number of firms existing at Nash equilibrium is bound and independent of the extent of the economy. On the demand side, the willingness to pay for a higher quality product is positively correlated with consumer income. On the supply side, quality improvements are imputable to endogenous fixed costs (R & D expenditure), while unit variable cost rises only slowly with quality. Hence all consumers rank goods in an increasing order of quality at unit variable cost. In these circumstances, according to the finiteness property derived by SS, the number of firms coexisting at equilibrium is limited, independently of industry size and of the product set. This result is due to price competition: the rivalry among firms producing higher quality goods reduces their prices to a level where all consumers are agreed on buying their products, forcing the lower qualities out of the market. In this mechanism, the role of R&D expenditure is crucial: in order to increase the quality of products, firms spend more in R&D and this limits the number of units in the market. In this oligopolistic equilibrium with a limited number of firms, the opening up of trade does not create a tendency towards the atomistic situation envisaged by monopolistic competition models with horizontal differentiation. On the contrary, the market enlargement associated with free trade induces the exit of firms, given that the initial constraint on the number of units coexisting at equilibrium remains. In the long run, higher returns on R&D investment - in a setting of enhanced economies of scale - will induce the surviving producers to improve their product quality. In this context, the gains from trade for consumers arise from the availability of higher quality goods at lower prices.

3. The results of Greenaway *et al.*

Greenaway, Hine and Milner (1994, 1995) and Greenaway, Milner and Elliott (1996) have built on the work of Abd-el-Rahman (1991) to measure HIIT and VIIT in the UK's trade with the EU and to analyse the different forces underlying the two types of IIT by regression analysis.

In this chapter, we take the analysis of Greenaway *et al.* further, by splitting VIIT into two components according to whether it is imports or exports which are of higher quality and by using more disaggregated trade data. We also use more disaggregated data. While our results cast doubt on the robustness of the econometric estimates of Greenaway *et al.*, they confirm the Greenaway *et al.* proposition that vertical intra-industry trade is to be explained in fundamentally different ways from horizontal intra-industry trade.

Greenaway *et al.* use differences between the unit values of imports and exports of products in the same SITC 5-digit class to distinguish between horizontal and vertical intra-industry trade. (The unit value is defined as the ratio of the value to the weight of a product being traded.) If the unit values of imports and exports diverge by more than 15%, this is taken as indicating that imports and exports are of different quality so that there is vertical intra-industry trade; while differences of less than 15% indicate horizontal intra-industry trade. They also present results using a unit-value divergence of 25%, and their results are robust to this change.

Greenaway *et al.* (1995) find that VIIT accounts for the greater part of IIT in UK-EU trade in 1988 when the 15% divergence criterion is used, and even with a 25% criterion, VIIT is half of IIT. In cross-industry regressions of IIT variables on a number of explanatory variables they find that there are significant differences in the regressions for HIIT and VIIT, drawing from this the message that the distinction between the two forms of IIT needs to be taken account of in empirical explanations of the phenomenon.

In this chapter, we focus particularly on the role of the variables that GHM use to measure product differentiation and we focus on the explanation of VIIT. The variable PDj (‘product differentiation’) is the number of 5-digit commodities in the 3-digit industry j. The variable VPDj (‘vertical product differentiation’) is the share of non-manual employment in total employment in industry j, and the naming of the variable signals the expectation that because quality is skill-intensive, vertical product differentiation will be associated with skill intensity. Other explanatory industry variables in GHM measure scale economies, number of firms, and the importance of multinationals.

However, this use of the VPD variable introduces a major methodological issue both for GHM’s work and for the work in this chapter. If skill-intensity is a determinant of VIIT, that will imply that a skill-abundant country will have a comparative advantage *within each sector* in higher quality products, but it does not necessarily imply that there will be more vertical intra-industry trade in sectors which are more skill-intensive. A good prediction of VIIT across sectors would be a variable which indicated *variance* in quality.

Perhaps surprisingly, the product differentiation variable is insignificant (and of changing sign) in all versions of the GHM regression for HIIT, and while some of the variables which seek to capture imperfect competition are significant they do not tell a consistent story about the model that might explain HIIT - industries with more scale economies tend to have less HIIT, but so do industries with more firms.

In the VIIT equations, the scale economy variable is insignificant, but the market structure variable indicates that industries with more firms have more VIIT. Since there is no theoretical presumption that this should be so, the suspicion must be that this result may arise from imperfect statistical division between HIIT and VIIT.

There is a significant negative relationship between PD and VIIT - industries with a wider range of products have less VIIT, which GHM indicate coincides with their theoretical presumption, though they do not explain this presumption. Arguably, the wider the product range, the more scope there is for all forms of IIT which would suggest a positive relationship between PD and VIIT. More interestingly, when PD is replaced by VPD in the regression for VIIT, the coefficient is positive and highly significant: industries with a high proportion of non-manual workers do have a strong tendency to have a high level of VIIT. By implication, sectors with a high proportion of non-manual workers have a high variance in product quality. Thus GHM conclude that it is important in empirical work to separate vertical and horizontal IIT.

Greenaway *et al.* (1996) (henceforth GME) extend the GHM analysis to include country-specific effects and therefore run regressions across countries and across industries.

The country-specific variables they investigate include capital stock per worker, and their regression equation for VIIT with all EU countries, again for 1988, that has both capital stock per worker and non-manual share in industry employment has significant positive coefficients for both variables: there is more VIIT with countries that have different levels of capital per worker and in industries that have more non-manual workers.

These relationships are, however, not stable: a regression for VIIT confined to EU 'North' countries has an insignificant (negative) coefficient on the capital stock variable while keeping the significant positive coefficient on the non-manual employment share in industry. The VIIT regression for EU 'South' countries has non-significant coefficients on both of these variables.

4. Introducing two types of vertical intra-industry trade

4.1 Methodology

There is a difficulty in the interpretation of the results that GHM and GME obtain about the relationship between VIIT and factor endowment and factor intensity variables: such results are supportive of the general idea that VIIT has a Heckscher-Ohlin explanation, but the GHM and GME regressions are not well designed to elicit convincing evidence. The problem is that we should not expect VIIT to be monotonically related either to country characteristics or to industry characteristics. A country would be expected to have a comparative advantage in skill-intensive or capital-intensive products in trade with countries compared to which it is well endowed with human or physical capital, and for a given set of trading partners we should expect to see different forms of VIIT in different sectors. The theory provides explanations for the dissection of VIIT within sectors rather than the distribution of VIIT across sectors.

We therefore here distinguish between two types of VIIT: 'upwards' vertical IIT in which the country is an exporter of higher quality products, $VIIT^+$; and 'downwards' vertical IIT in which the country is an exporter of lower quality products, $VIIT^-$. The formal definitions follow very naturally from equations (1.2) and (1.4) in the introductory chapter. For sector *j*:

$$VIIT_j^+ = \frac{\sum_{i \in U}(X_i + M_i) - \sum_{i \in U}|X_i - M_i|}{\sum_i (X_i + M_i)} \tag{1}$$

where the summation $i \in U$ is over those commodities for which

$$\frac{UV_i^x}{UV_i^m} \geq 1 + \alpha \tag{2}$$

while

$$VIIT_j^- = \frac{\sum_{i \in D}(X_i + M_i) - \sum_{i \in D}|X_i - M_i|}{\sum_i (X_i + M_i)} \tag{3}$$

where the summation $i \in D$ is over those commodities for which

$$\frac{UV_i^x}{UV_i^m} \leq 1 - \alpha \tag{4}$$

Since the sets U and D are mutually exclusive and exhaustive of V, (1.6) now becomes

$$IIT_j = HIIT_j + VIIT_j^+ + VIIT_j^- \tag{5}$$

Empirical investigation of the significance of the distinction between upward and downward vertical IIT has been undertaken using different data from GHM and GME. Our industries are the 3-digit NACE industries of the UK on which statistics are obtained from the European Commission's INDE database. Commodity level trade data at the 8-digit level comes from the Commission's COMEXT data. The COMEXT databank includes a concordance with the NACE industrial classification, so from COMEXT data, in accordance with the formulae set out above and assuming α = 0.2, it is possible to derive statistics at industry level for HIIT, VIIT+ and VIIT- (see Appendix for more details).

The use of 8-digit commodity data has the advantage that at this more disaggregated level, one can have more confidence that unit value differences genuinely reflect quality differences in otherwise similar products[15]. For example, the 8-digit CN code 84182199 refers to 'Household refrigerators, compression type, capacity between 250 and 340 litres, excluding table models and building-in types', one of 68 products which correspond to the 3-digit NACE sector 'domestic electrical appliances', whereas the SITC 5-digit code 77521 covers all of 'Refrigerators, household type (electric or other), whether or not containing a deep-freezer compartment'. At the 5-digit level, UV differences might reflect the fact that refrigerators of quite different kinds were being imported and exported rather than being a reliable indicator of quality differences. By contrast, with the narrow 8-digit product definition, UV differences would properly signal quality differences between imported and exported refrigerators of this particular specification. Given the disaggregated level of calculation, it would be more appropriate to use the term 'intra-product trade' than 'intra-industry trade', but I shall retain the conventional terminology. It is, however, necessary to remember that the statistics with which we are working are of sectoral levels of intra-product trade.

From our data sources, the variables shown in the table below were derived for each 3-digit NACE sector ("industry i") for the UK. Thus in addition to the IIT indices we have three variables (SCA, COMP, SUBSE) associated with market structure and two (SKUN, KL) which are associated with factor endowments. (Unlike GHM, I do not include a variable for the importance of multinational enterprises in a sector.)

[15] Here unit values are calculated as the ratio between the value of the trade flow (import or export of the 8-digit commodity) and its weight. The consistent use of supplementary units for volumes was not possible because such data are not comprehensive.

Variable	Name	Definition
IIT_i	Index of total intra-industry trade	eqn (1.1)
$HIIT_i$	Index of horizontal intra-industry trade	eqn (1.2)
$VIIT_i$	Index of vertical intra-industry trade	eqn (1.4)
$VIIT^{+}_{i}$	Index of up-market VIIT	eqn (1)
$VIIT^{-}_{i}$	Index of down-market VIIT	eqn (3)
SCA_i	Scale economies	turnover per unit
$COMP_i$	Competition	number of units in sector
$SUBSE_i$	Horizontal differentiation	number of 8-digit CN products in 3-digit NACE sector
$SKUN_i$	Skill-intensity	ratio of non-manual to manual workers
KL_i	Capital intensity	ratio of investment to employment

The specification adopted by GHM for total IIT is a standard specification adopted in many tests of industry-specific determinants of intra-industry trade:

$$IIT_i = \alpha_0 + \alpha_1 SUBSE_i + \alpha_2 SCA_i + \alpha_3 COMP_i + e_i \tag{6}$$

where the expected signs of estimated coefficients $\alpha 1$, $\alpha 2$ and $\alpha 3$ would be ambiguous for the reason that total IIT includes both forms of product differentiation and large or small numbers cases.

Equation (6) can be estimated separately for HIIT and VIIT:

$$HIIT_i = \alpha_0 + \alpha_1 SUBSE_i + \alpha_2 SCA_i + \alpha_3 COMP_i + e_i \tag{7}$$

$$VIIT_i = \alpha_0 + \alpha_1 SUBSE_i + \alpha_2 SCA_i + \alpha_3 COMP_i + e_i \tag{8}$$

Now, we should expect differences in the explanation of HIIT and VIIT. At this stage, following GHM, such diversity should be reflected in the signs of coefficients.

In accordance with GHM's preferred explanation for HIIT, in the equation (7) the expected signs of estimated coefficients would be $\alpha 1 > 0$, $\alpha 2 < 0$, $\alpha 3 > 0$, reflecting the expectation that more horizontal IIT will be associated with more horizontal product differentiation, smaller firms and more firms per industry.

By contrast, in the case of VIIT, the expected signs of estimated coefficients would be $\alpha 1 < 0$, $\alpha 2 \lesseqgtr 0$, $\alpha 3 \gtreqless 0$. In equation (8) the signs of the scale and competition variables are ambiguous because the large group (FK) and small group (SS) explanations of vertical product differentiation give different predictions. The negative sign for $\alpha 1$ follows GHM's assumption though I have already expressed my doubts about this assumption.

Again, following GHM's preferred specification for VIIT, I replace the variable for horizontal product differentiation with the skill-intensity variable. It also turns out that there is a strong statistical case for the inclusion of the capital-intensity variable, giving the equation:

$$VIIT_i = \alpha_0 + \alpha_1 SKUN_i + \alpha_2 SCA_i + \alpha_3 COMP_i + \alpha_4 KL_i + e_i \quad (9)$$

GHM expect a positive sign for $\alpha 1$ on the basis of the FK explanation of VIIT in Heckscher-Ohlin terms. The expected sign of $\alpha 1$, however, needs to be carefully considered. VIIT is defined as the exchange of high-quality for low-quality goods within a sector, and quality is hypothesised to be related to skill-intensity. As I have already argued, we would expect the volume of VIIT to be relatively high in sectors within which there was high variance in the skill-intensity of production of product varieties. But we have no data on this.

We also need to recall, as Leamer (1984) has emphasised, that the Heckscher-Ohlin approach requires data on factor intensities of production, factor endowments of countries, and trade flows, so a Heckscher-Ohlin account relating the trade flows of the UK to the characteristics of sectors requires also some account of some assumptions about the factor endowments of the UK relative to the relevant trade partners.

If the UK is well-endowed with skill (capital) and if high quality goods are more skill-intensive (capital-intensive) than low-quality goods, then we would expect the UK to have a comparative advantage in skill-intensive (capital-intensive) sectors and within these sectors to be a net exporter of high quality goods, and we would observe an association across sectors between ‘up-market’ VIIT and the skill-intensity (capital-intensity) of production. We would not expect to observe much ‘down-market’ VIIT, and its relationship to the skill-intensity (capital-intensity) of production is unpredictable.

Therefore with up-market and down-market VIIT separately identified, we have two equations:

$$VIIT_i^+ = \alpha_0 + \alpha_1 SKUN_i + \alpha_2 SCA_i + \alpha_3 COMP_i + \alpha_4 KL_i + e_i \quad (10)$$

$$VIIT_i^- = \alpha_0 + \alpha_1 SKUN_i + \alpha_2 SCA_i + \alpha_3 COMP_i + \alpha_4 KL_i + e_i \quad (11)$$

where the expected sign of estimated coefficients for SKUN and KL would be positive in equation (10) and ambiguous in equation (11).

In this chapter, the equations illustrated above have been estimated for the UK in 1990 by carrying out standard OLS cross-section regressions on 63 observations (industrial sectors).16 UK intra-industry trade has been analysed with regard to three geographical groupings: total trade, intra-EU trade and extra-EU trade.

4.2 Total intra-industry trade

Since the theoretical presumptions discussed in the previous section are somewhat tentative, it is important to explore the full range of possibilities. I therefore follow the procedure of starting from a common specification with all regressors inside and then by dropping out insignificant variables systematically and one at a time. I report the best specification for each geographical grouping. Whenever heteroskedasticity problems occur, the reported OLS estimates are based on adjusted White heteroskedasticity-consistent standard errors.

[16]The sectors included are the 3 digit sectors from NACE 26 onwards (thus not including the extraction and chemicals industries). A number of sectors (17) have been excluded because of missing data.

Table 1 - Industry specific determinants of UK total intra-industry trade. 1990

Dependent variable: IIT	OLS				Observations 63		Diagnostics:		
Regressors	Constant	SUBSE	SKUN	SCA	COMP	KL	Funct.form[a]	Normality[b]	Heteroskedasticity[c]
Total trade									
	0.542	-0.00046	1.108	-0.00048	0.00013	-24.571	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.29	(9.42)***	(-1.59)*	(0.85)	(-1.63)*	(2.76)***	(-2.52)***	0.80	0.77	0.69
	0.558	-0.00049			0.00015	-20.472	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.26	(11.51)***	(-1.73)*			(3.19)***	(-2.93)***	2.53	0.16	0.61
Intra-EU trade									
	0.624	-0.0006	0.288	-0.000048	0.00014	-32.075	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.44	(12.69)***	(-2.41)**	(0.26)	(-0.19)	(3.46)***	(-3.85)***	0.54	3.09	0.02
	0.631	-0.00061			0.00014	-30.59	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.44	(15.57)***	(-2.61)***			(3.69)***	(-5.25)***	0.69	3.05	0.02
Extra-EU trade									
	0.367	-0.00032	1.783	-0.00072	0.00014	-24.49	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.31	(6.07)***	(-1.06)	(1.31)	(-2.33)**	(2.86)***	(-2.39)**	0.03	1.09	0.15
	0.395	-0.00037			0.00017	-17.63	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.24	(7.58)***	(-1.22)			(3.39)***	(-2.35)**	1.43	1.55	0.02
	0.337		2.142	-0.00075	0.00013	-26.09	F(1, 57)	CHI-SQ (2)	F(1,61)
R^2: 0.29	(6.33)***		(1.63)*	(-2.46)**	(2.66)***	(-2.58)***	0.78	1.74	1.63

[a] Ramsey's RESET test. [b] Based on a test of skewness and kurtosis of residuals. [c] Based on the regression of squared residuals on squared fitted values.
*** 1% level of significance, ** 5% and * 10%

Table 1 illustrates the regression results for total IIT. If we look at total trade, the best results are obtained when IIT is regressed on *SUBSE*, *COMP* and *KL.* The negative sign on *SUBSE* (the proxy variable for attribution differentiation), the positive sign on *COMP* (the market structure variable) and the high level of significance associated with factor intensity variable *KL* (but with negative coefficient) may indicate that total IIT pattern is driven by vertical IIT , particularly in the form of large numbers model. The same pattern applies to the case of intra-EU trade with a higher level of significance of coefficients. In the case of extra-EU trade, the impression that IIT is dominated by the large numbers models of vertical IIT is even stronger: now the best specification includes the specific proxy for vertical product differentiation *SKUN* (in the place of SUBSE), *SCA*, *COMP* and *KL.* The positive sign on *SKUN* is a result in line with equation (10) for up-market vertical intra-industry trade, although the negative sign on KL does not entirely bear out this interpretation (for the sake of comparison, I also report the results for the extra-EU regression equation with the specification which was preferred for total and intra-EU trade).

In the end, the general picture that emerges from this first set of regressions is that the previous evidence supporting the large numbers model of IIT is verified: the negative coefficient associated with *SCA* in conjunction with the positive sign on *COMP* may indicate that a lower minimum efficient scale favours firms' access to market.[17] But, at the same time, the results contrast with the traditional conviction – as it emerges from previous empirical studies - that horizontal intra-industry trade is the dominant form of IIT*.* On the contrary, the negative sign on *SUBSE* and the significance associated with factor

[17] The *COMP* coefficient shows a high and stable level of significance (1%) in comparison with the *SCA* coefficient. In this regard , Greenaway, Hine and Milner (1995) have obtained the opposite result.

intensity variables (especially KL) suggest that the pattern of IIT is driven by vertical intra-industry trade. Except for the inclusion of HO variables, on the whole this first set of regressions on total *IIT* yields an outcome reasonably in line with the estimates of Greenaway, Hine and Milner (1995).

I now follow GHM and separate horizontal and vertical IIT. If we look at the IIT indices computed at the 8-digit level across all sectors in table 2, the UK's intra-EU trade divides almost equally into 26.5% VIIT and 25% HIIT, while the UK's extra-EU trade divides into 30% VIIT and 10% HIIT, and the UK's total trade divides into 33% VIIT and 22% HIIT. In all cases, VIIT is the largest part of trade flows and this suggest that it is worth to test the determinants of IIT separately for the VIIT and HIIT.

Table 2 - UK Total, Horizontal and Vertical Intra-industry trade. Grubel-Lloyd indices (%)[a] 1990

	IIT	HIIT	VIIT	VIITUP	VIITDO
Total trade	55.0	22.0	33.0	20.0	13.0
Intra-EU trade	51.5	25.0	26.5	12.2	14.3
Extra-EU trade	40.0	10.0	30.0	21.0	9.0

[a]Calculated at 8-digit level across 63 manufacturing sectors and 5401 subgroups

4.3 Horizontal intra-industry trade

Table 3 - Industry specific determinants of UK horizontal intra-industry trade. 1990

Dependent variable: HIIT	OLS				Observations 63		Diagnostics:		
Regressors	Constant	SUBSE	SKUN	SCA	COMP	KL	Funct.form[a]	Normality[b]	Heteroskedasticity[c]
Total trade									
	0.160	-0.000036	-0.230	-0.00025	0.000011	8.570	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.07	(3.58)***	(-0.16)	(-0.23)	(-1.08)	(0.30)	(1.37)	1.60	3.09	3.14
Intra-EU trade									
	0.234	0.000026	-0.678	-0.000014	0.000015	-1.407	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.04	(5.02)***	(0.11)	(-0.65)	(-0.06)	(0.38)	(-0.18)	0.001	30.51	0.19
Extra-EU trade[d]									
	0.06	-0.000058	0.597	-0.00022	0.000019	1.21	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.06	(1.86)*	(-0.40)	(0.48)	(-1.13)	(0.62)	(0.10)	3.98	1.76	4.51

[a] Ramsey's RESET test. [b] Based on a test of skewness and kurtosis of residuals. [c] Based on the regression of squared residuals on squared fitted values.
[d] OLS estimation based on Adjusted White's Heteroskedasticity-Consistent S.E.'s. *** 1% level of significance, ** 5% and * 10%

Table 3 displays the results of the *HIIT* estimates. No variable shows a satisfactory level of significance. Only the *SCA* coefficient displayed a 10% and 1% level of significance – respectively in total trade and in extra-EU – when this variable was included in the estimated equation with *KL* only (which still remained insignificant). Also when Tobit estimates were carried out in the place of OLS or variables entered in the estimated equation in logarithms, no appreciable outcome was obtained[18].

[18] A number of near zero values for the dependent variable made it worth considering this transformation of data in order to improve the overall explanatory power of the equation.

In GHM's estimates for *HIIT,* an unexpected negative sign on *COMP* combined with an insignificant coefficient for *SUBSE* (the specific proxy for horizontal differentiation) led them to consider the estimated equation for *HIIT* to be less robust than those for *IIT* and *VIIT*. While my results for HIIT are completely insignificant in comparison with those of GHM, the general message is somewhat similar – of weak statistical results not entirely in line with theoretical expectations. In interpreting the weakness of my results for HIIT, it needs to be remembered that IIT is here being measured at a very disaggregated level: what we have found is the absence of any relations across 3-digit sectors between the characteristics of the sectors and the level of intra-product trade within sectors. The adoption here of a disaggregation at the product level may explain why my results for HIIT are worse than GHM's results. In effect, as discussed above, the 8-digit level is appropriate to measure VIIT because one can have more confidence that unit value differences genuinely reflect quality differentiations in otherwise similar products. But, at the same time, the disaggregation at the product level (8-digit) risks the loss of information about attribute differentiation in HIIT. Recalling the previous example, at the 5-digit level we identify the exchange of refrigerators with or without freezer. This type of trade reflects genuinely the exchange of similar goods differentiated by attribute (in this case, the presence or not of the freezer), that is HIIT. In choosing a level of disaggregation more appropriate to the identification of VIIT, we are losing a substantial amount of HIIT. So a possible reason of my unsatisfactory estimates for HIIT could be imputed to the level of disaggregation.

4.4 Vertical intra-industry trade

As table 4 shows, more robust results emerge for *VIIT*. The pattern of VIIT substantially resembles results obtained for total IIT, confirming the impression that the total IIT model is driven by vertical intra-industry trade. In the case of geographical groupings total trade and intra-EU trade, the best specification has *SUBSE*, *COMP* and *KL* as explanatory variables (as obtained in IIT estimates; see table 1). In the case of extra-EU trade, the best result emerges when *SUBSE* and *SKUN* are dropped out from the initial common specification and VIIT is regressed on *SCALE*, *COMP* and *KL*. Again, the signs on coefficients estimated for *COMP* (+) and *SCALE* (-) seem to support the large numbers model of vertical intra-industry trade.

GHM attach great importance to the negative expected sign on the horizontal differentiation variable in estimated equation for VIIT (SUBSE here and PD_j in GHM), but in my results the factor intensity variable *KL* performs better than *SUBSE* (KL is highly significant in all regressions for VIIT).

Table 4 - Industry specific determinants of UK vertical intra-industry trade. 1990

Dependent variable: VIIT	OLS				Observations 63		Diagnostics:		
Regressors	Constant	SUBSE	SKUN	SCA	COMP	KL	Funct.form[a]	Normality[b]	Heteroskedasticity[c]
Total trade									
	0.382	-0.00043	1.335	-0.00023	0.00012	-33.147	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.44	(8.76)***	(-1.94)**	(1.36)	(-1.04)	(3.32)***	(-4.49)***	0.42	15.9	0.002
	0.413	-0.0005			0.00013	-26.32	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.42	(11.32)***	(-2.35)**			(3.77)***	(-5.01)***	0.15	15.20	0.05
Intra-EU trade [d]									
	0.391	-0.00062	0.967	-0.000034	0.00013	-30.67	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.42	(8.61)***	(-2.72)***	(0.95)	(-0.15)	(3.37)***	(-4.00)***	0.0004	0.23	3.05
	0.417	-0.00069			0.00013	-24.99	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.41	(9.58)***	(-3.78)***			(5.38)***	(-5.83)***	0.18	0.04	4.35
Extra-EU trade									
	0.311	-0.00026	1.186	-0.0005	0.00013	-25.70	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.39	(6.68)***	(-1.13)	(1.13)	(-2.10)**	(3.23)***	(-3.25)***	0.24	3.40	0.65
	0.330	-0.00029			0.00014	-21.25	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.34	(8.26)***	(-1.26)			(3.73)***	(-3.70)***	0.66	2.66	0.59
	0.315			-0.00029	0.00012	-19.24	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.35	(8.72)***			(-1.68)*	(3.25)***	(-3.34)***	0.25	4.27	0.37

[a] Ramsey's RESET test. [b] Based on a test of skewness and kurtosis of residuals. [c] Based on the regression of squared residuals on squared fitted values.
[d] In the second regression, OLS estimation is based on Adjusted White's Heteroskedasticity-Consistent S.E.'s. *** 1% level of significance, ** 5% and * 10%

In addition, KL also works better in comparison with the other factor intensity variable SKUN, which is highly significant in GHM's estimates for VIIT but is insignificant here. The inverse relationship between VIIT and capital-intensity is not so surprising if we look at characteristics of sectors; data reveals that the most capital-intensive industries are those with less scope for product differentiation: chemical and food processing (brewing and malting, sugar manufacturing and refining, grain milling, etc.)19. In effect, the negative sign on KL does not support an Heckscher-Ohlin story of vertical intra-industry trade, but I argued earlier that once factor-intensity variables are brought in to the explanation of VIIT, it is desirable to look separately at the up-market (VIIT+) and down-market (VIIT-) components of VIIT. Of the UK's intra-EU trade, 26.5% is VIIT at the 8-digit level and that divides more or less equally into 12.2% up-market and 14.3% down-market. In extra-EU trade, the 30% total of 8-digit VIIT is 21% up-market and 9% down-market. For total trade, 33% is VIIT, of which 20% is up-market and 13% down-market (see table 2).

Tables 5 and 6 show the statistical results for VIIT+ and VIIT- respectively.

[19] The rank of the first ten 3 digit sectors with higher values of KL is: 427, 260, 425, 411, 428, 424, 420, 416, 351, 371 (for the description of sectors, see table 1A in appendix).

Table 5 - Industry specific determinants of UK up-market vertical intra-industry trade. 1990

Dependent variable: $VIIT^+$	OLS				Observations 63		Diagnostics:		
Regressors	Constant	SUBSE	SKUN	SCA	COMP	KL	Funct.form[a]	Normality[b]	Heteroskedasticity[c]
Total trade [d]									
	0.260	-0.00032	-0.145	0.000024	0.00011	-15.33	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.31	(5.85)***	(-1.52)	(-0.21)	(0.23)	(2.56)***	(-3.22)***	3.07	1.62	5.32
	0.26	-0.00032		0.0000015	0.00011	-16.08	F(1, 57)	CHI-SQ (2)	F(1,61)
R^2: 0.31	(7.05)***	(-1.53)		(0.03)	(2.51)***	(-4.55)***	3.24	1.74	4.97
	0.234				0.000098	-15.67	F(1, 59)	CHI-SQ (2)	F(1,61)
R^2: 0.28	(7.20)***				(2.07)**	(-4.45)***	1.45	2.93	5.32
Intra-EU trade [d]									
	0.178	-0.00038	0.374	0.0002	0.000091	-11.94	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.25	(4.08)***	(-1.97)**	(0.53)	(1.52)	(2.00)**	(-2.88)***	3.95	3.07	7.82
	0.186	-0.0004		0.00026	0.000094	-9.99	F(1, 57)	CHI-SQ (2)	F(1,61)
R^2: 0.25	(5.43)***	(-2.15)**		(2.93)***	(2.00)**	(-2.91)***	3.32	2.88	9.37
Extra-EU trade [d]									
	0.253	-0.0003	-0.496	-0.00015	0.00011	-11.24	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.33	(6.24)***	(-1.39)	(-0.56)	(-1.09)	(2.40)**	(-1.97)**	0.19	2.77	6.01
	0.241	-0.00027		-0.00023	0.00011	-13.83	F(1, 57)	CHI-SQ (2)	F(1,61)
R^2: 0.33	(7.34)***	(-1.33)		(-5.62)***	(2.36)**	(-4.06)***	0.42	2.55	5.55
	0.221			-0.00021	0.000094	-13.59	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.30	(7.06)***			(-5.13)***	(2.04)**	(-4.00)***	0.14	3.26	5.66

[a] Ramsey's RESET test. [b] Based on a test of skewness and kurtosis of residuals. [c] Based on the regression of squared residuals on squared fitted values.
[d] OLS estimation based on Adjusted White's Heteroskedasticity-Consistent S.E.'s. *** 1% level of significance, ** 5% and * 10%

Comparing Tables 5 and 6, we see quite different results for the two forms of VIIT. The market structure variable *COMP* is significant for up-market VIIT but not for down-market VIIT. This implies that UK has a comparative advantage in high quality products in sectors where there are many firms; but the number of firms has no effect in predicting sectors in which the UK has a comparative advantage in low quality products. Another difference is that the proxy variable for product attribution differentiation *SUBSE* has the negative impact which GHM expect on up-market VIIT (only intra-EU trade) but not on down-market VIIT. On the contrary, the skill intensity variable *SKUN* has a significant impact on down-market VIIT (only extra-EU trade) but not on up-market VIIT. These results show the importance of dividing VIIT in up-market and down-market flows, although it is not easy to offer a fully consistent interpretation of the picture.

Table 6 - Industry specific determinants of UK down-market vertical intra-industry trade. 1990

Dependent variable: $VIIT^-$	OLS				Observations 63		Diagnostics:		
Regressors	Constant	SUBSE	SKUN	SCA	COMP	KL	Funct.form[a]	Normality[b]	Heteroskedasticity[c]
Total trade									
	0.122	-0.000099	1.480	-0.00025	0.000006	-17.81	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.13	(3.14)***	(-0.50)	(1.69)*	(-1.29)	(0.20)	(-2.70)***	0.54	169.41	1.20
	0.113		1.595	-0.00027		-18.34	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.13	(3.58)***		(1.93)**	(-1.41)		(-2.90)***	0.03	180.92	0.62
	0.148					-10.18	F(1, 60)	CHI-SQ (2)	F(1,61)
R^2: 0.07	(5.70)***					(-2.19)**	0.17	145.03	2.41
Intra-EU trade [d]									
	0.213	-0.00025	0.592	-0.00024	0.000037	-18.73	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.22	(5.09)***	(-1.38)	(0.63)	(-1.72)*	(0.81)	(-3.20)***	0.07	22.66	5.59
	0.198		0.964	-0.00029		-20.74	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.19	(5.89)***		(1.09)	(-1.45)		(-3.08)***	0.23	24.97	2.51
	0.219					-16.63	F(1, 59)	CHI-SQ (2)	F(1,61)
R^2: 0.16	(7.99)***					(-3.40)***	0.04	26.21	2.06
Extra-EU trade									
	0.06	0.000035	1.68	-0.00035	0.000014	-14.45	F(1, 56)	CHI-SQ (2)	F(1,61)
R^2: 0.15	(1.81)*	(0.22)	(2.31)**	(-2.14)**	(0.53)	(-2.65)***	0.01	109.65	1.23
	0.068		1.712	-0.00037		-14.83	F(1, 58)	CHI-SQ (2)	F(1,61)
R^2: 0.15	(2.59)***		(2.50)***	(-2.34)**		(-2.82)***	0.0005	94.05	1.19

[a] Ramsey's RESET test. [b] Based on a test of skewness and kurtosis of residuals. [c] Based on the regression of squared residuals on squared fitted values.
[d] In the first regression, OLS estimation is based on Adjusted White's Heteroskedasticity-Consistent S.E.'s. *** 1% level of significance, ** 5% and * 10%

In addition, the separation of vertical intra-industry trade into $VIIT^+$ and $VIIT^-$ components makes more clear the geographical differentiation of the UK pattern of VIIT.

If we compare tables 5 and 6, first for intra-EU trade, we see quite different results for the two forms of VIIT. In the best specification, intra-EU $VIIT^+$ is negatively associated with *SUBSE*, as predicted, positively related to *SCA* and to *COMP* and negatively related to capital-intensity *KL* (table 5). But intra-EU $VIIT^-$ is poorly determined, with the negative relationship with capital-intensity the only significant statistical relationship (table 6).

For extra-EU trade, again there are different results for the two forms of VIIT, but with a different pattern from intra-EU trade. Now down-market trade is positively related to the skill-intensity variable *SKUN*, negatively to scale economies variable *SCA*, and negatively to capital-intensity variable *KL* (table 6), while the pattern of up-market trade is similar to results obtained for extra-EU total VIIT (compare table 5 and 4) with a negative association with *SCA* and *KL* and a positive relationship with *COMP*. With reference to the sign on coefficient of *SCA*, it is worth underlining the difference between intra-EU and extra-EU trade: in the first case, the sign is positive, in the other case it is negative. In other words, economies of scale have a positive impact on intra-EU $VIIT^+$ trade and a negative impact on extra-EU $VIIT^+$ and $VIIT^-$.

To sum up the picture emerging from OLS estimates for VIIT, let me recall results variable by variable.

KL is a significant variable (with negative coefficient) for all version of VIIT. Since VIIT should be explained by the variance in quality within sectors, this seems to imply that capital-intensive sectors have less vertical product differentiation. In effect data reveals that capital-intensive sectors are those producing more standardised industrial products.

COMP is a significant variable for $VIIT^+$, but not for $VIIT^-$. As already argued, this result shows the importance of separating $VIIT^+$ from $VIIT^-$.

Again, the division of VIIT in up-market and down-market components turns out to be useful when the role of economies of scale are investigated. *SCA* has a positive impact on Intra-EU $VIIT^+$ and a negative impact on Extra-EU $VIIT^+$ and $VIIT^-$. These effects, revealing the geographical differentiation of UK VIIT, are much less clear when VIIT is not disaggregated.

SUBSE has the negative impact which GHM expect only on intra-EU $VIIT^+$ and *SKUN* has positive impact only on Extra-EU $VIIT^-$. Again, this outcome suggests that separate testing of the upwards and the downwards components of *VIIT* is worth pursuing because it yields a more accurate interpretation of the sign on the skill-intensity variable, so that the direction of comparative advantage with regard to the quality of goods can be inferred**.**

4.5 Sensitivity of results

A remark is in order concerning the sensitivity of estimates to the dispersion criterion adopted to disentangle HIIT and VIIT.

As discussed in the previous section, the methodology proposed by GHM in order to divide *HIIT* from *VIIT* in trade data incorporates a procedure based on a discretionary element: the *ad hoc* definition of the range of variation for UV. GHM, after testing the robustness of econometric results by adopting two alternative criteria (15%, 25%), concluded that estimates remained substantially unchanged. As already mentioned, in all my estimates I have adopted a criterion based on 20% range of variation for UV. Table 7 shows how sensitive OLS estimates for *HIIT* and *VIIT* are when the UV dispersion criterion changes.

Table 7 - Sensitivity of OLS estimates to the change of the criterion for separating HIIT from VIIT (Intra-EU trade)

	OLS				Observations 63		Diagnostics:			
Regressors	Constant	SUBSE	SKUN	SCA	COMP	KL	Funct.form[a]	Normality[b]	Heteroskedasticity[c]	
Dependent variable: HIIT										
10%	0.977	0.000065	-0.42	0.0000217	-0.000011	5.79	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.02
	(2.77)***	(0.37)	(-0.53)	(0.12)	(-0.36)	(0.97)	0.56	257.25	0.15	
15%[d]	0.189	-0.00006	-1.133	0.000093	0.000028	4.71	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.03
	(4.21)***	(-0.26)	(-1.11)	(0.41)	(0.75)	(0.62)	0.56	56.06	0.44	
20%[e]	0.234	0.000026	-0.678	-0.000014	0.000015	-1.407	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.04
	(5.02)***	(0.11)	(-0.65)	(-0.06)	(0.38)	(-0.18)	0.001	30.51	0.19	
30%	0.37	-0.00014	-0.41	-0.00018	0.000028	-10.53	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.13
	(7.33)***	(-0.57)	(-0.36)	(-0.72)	(0.68)	(-1.23)	1.03	2.30	2.36	
Dependent variable: VIIT										
10%	0.526	-0.00066	0.714	-0.00007	0.00015	-37.87	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.50
	(10.98)***	(-2.78)***	(0.66)	(-0.28)	(3.82)***	(-4.67)***	0.03	0.26	0.53	
15%[d]	0.434	-0.00054	1.421	-0.00014	0.00011	-36.79	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.42
	(9.07)***	(-2.23)**	(1.32)	(-0.58)	(2.85)***	(-4.54)***	0.06	0.06	2.84	
20%[e]	0.391	-0.00062	0.967	-0.000034	0.00013	-30.67	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.42
	(8.61)***	(-2.72)***	(0.95)	(-0.15)	(3.37)***	(-4.00)***	0.0004	0.23	3.05	
30%	0.25	-0.00045	0.69	0.00013	0.00011	-21.54	F(1, 56)	CHI-SQ (2)	F(1,61)	R^2: 0.42
	(7.24)***	(-2.55)**	(0.88)	(0.76)	(3.87)***	(-3.62)***	2.73	3.70	0.40	

[a] Ramsey's RESET test. [b] Based on a test of skewness and kurtosis of residuals. [c] Based on the regression of squared residuals on squared fitted values.
[d] GHM's criterion. [e] My criterion. *** 1% level of significance, ** 5% and * 10%

By moving from a more strict (10%) to a more generous (30%) definition of HIIT – that is from a more generous to a more strict definition of VIIT – OLS estimates remain substantially unchanged: no large deviation in the level of significance of variables. Beyond the level of significance, even if we look at the signs of the coefficients, no consistent pattern emerges when we change the definition of HIIT and VIIT. For example, if we consider estimates for HIIT, by moving from 10% to 15% criterion (from a more severe to a more generous definition of HIIT), the sign on horizontal differentiation variable *SUBSE* changes from positive to negative, as expected; but subsequently by moving from 15% to 20% criterion, the sign becomes again positive, which is inconsistent (and all remaining insignificant). Substantially, table 7 provides evidence that the element of arbitrariness implicit in the HIIT-VIIT definition (dispersion criterion for UV) does not seem to condition the empirical results[20].

4.6 Interpretation of results

The picture emerging from my estimates for the components of UK intra-industry trade appears quite fragmented and calls for a general interpretation of results.

[20] When Intra-EU VIIT is regressed on SKUN, SCALE and COMP, the skill intensity variable becomes significant with negative sign by moving from 15% to 10% criterion (a very large definition of VIIT). This is the only case in which the change of the dispersion criterion for UV induces a substantial variation of the level of significance associated with an explanatory variable. Furthermore, this case doesn't represent the preferred specification.

With respect to the recent methodology suggested by Greenaway, Hine and Milner for disentangling and investigating the two types of IIT, in my analysis I have introduced two innovative features: 1) computation of UVs at a deeper level of product disaggregation (8-digit CN level) in order to obtain more reliable indicators of quality differences; 2) division of VIIT in up-market and down-market components in order to model a more precise specification of the expected link between vertical intra-industry trade and the specific explanatory variables for quality differentiation.

The empirical results suggest that these innovations turn out to be useful for a more accurate description of vertical intra-industry trade, but with the by-product of an less satisfactory analysis of horizontal intra-industry trade. As my estimates have shown, HIIT is poorly explained by the theories we have considered. This lack of results for HIIT could be linked to the treatment of data and, relating to this, the criterion adopted for separating HIIT from VIIT could play a role. But, as shown in the previous section, estimates are unaffected by the change of the criterion assumed for defining HIIT-VIIT.

While the value of the criterion for dividing the two forms of intra-industry trade does not seem to be relevant, it is still in the treatment of data that the reason for the poor performance of HIIT should be looked for. As I have done, GHM gained estimates for HIIT less robust than those they obtained for VIIT, but their results for HIIT were better than mine. We have already observed that the better performance of GHM'estimates for HIIT in comparison with my results could be explained by the level of disaggregation of data. GHM's use of the 5-digit level of disaggregation retains in their measure of HIIT inter-product exchanges which genuinely reflect horizontal differentiation, that is the exchange of similar products differentiated by attributes, without incurring big problems of categorical aggregation. The deeper disaggregation to the 8-digit product level hides horizontal differentiation in which the attribute variety exists in inter-product trade but not in intra-product trade. So the disaggregation at the product level here adopted could explain the lack of results for HIIT.

Conversely, the 8-digit level of disaggregation is more appropriate than the 5-digit level in the definition of VIIT: only in intra-product trade we expect that unit value differences genuinely reflect quality differences. In fact the estimates which I have carried out for VIIT turn out to be more robust than HIIT results.

Regression results for VIIT show that industries with less attribute differentiation, with more firms and with less capital intensity have more VIIT. The large numbers model of VIIT seems to be confirmed here, although the variable for economies of scale is not significant in all regressions and does not display a stable sign. The inverse relationship between VIIT and attribute differentiation expected by GHM is confirmed here. However, in my estimates, the capital-intensity variable seems to work much better than product differentiation, being significant in all regressions and at a higher level.

In GHM's estimates for VIIT, the specific regressor for vertical differentiation they consider (skill-intensity) is as significant as the product differentiation variable and both turn out to be alternative explanatory factors for VIIT. But, in my estimates, the skill-intensity variable becomes significant only when VIIT is divided into up-market and down-market components. This result suggests that it is worth to separate $VIIT^+$ from $VIIT^-$, also because this separation makes clearer the geographical differentiation of UK vertical intra-industry trade (the different pattern of intra-EU vs extra-EU trade, as shown).

However, the link between factor-intensity variables and $VIIT^+$ and $VIIT^-$ respectively does not emerge in the way we expected. For both components of vertical intra-industry trade, the capital-intensity variable shows a negative coefficient, whereas it should be positive for up-market trade. As we have already discussed, this result is explained by the characteristics of the most capital-intensive sectors (industries producing standardized industrial goods with less scope for product differentiation).

Also results concerning the skill-intensity variable are not in line with a Heckscher-Ohlin view of VIIT. As shown, this variable is significant with positive sign in estimates for extra-EU down-market VIIT; in other words, regression results suggest that the most skill-intensive sectors are those in which the UK sells more low quality goods to extra-EU partners in exchange for high quality goods. What is the explanation for this outcome?

The presence of vertical disintegration in UK trade flows could help to interpret this result. In other words, in skill-intensive sectors the UK could export to extra-EU countries products to be processed and then reimported. This circumstance could imply that UVs of UK exports are lower than UVs of UK imports ($UVX^{UK}<UVM^{UK}$) not because the quality of UK goods is low but just because commodities imported are more processed than commodities exported.

Another potential reason for this result is that the “extra-EU” category covers too wide a range of trade partners to give a good basis for a study of Heckscher-Ohlin based trade. In other words, the UK is not obviously skill-abundant relative to extra-EU, a grouping which includes countries like US, Japan, Canada, etc. The separation of advanced countries from less advanced countries in extra-EU grouping would have been helpful in order to test factor proportion explanation of VIIT appropriately.

5. Conclusions

This chapter has offered empirical evidence concerning the industry-specific determinants of UK horizontal and vertical intra-industry trade in 1990.

The estimates illustrated in this chapter have shown that horizontal intra-industry trade is inadequately explained by the models we have considered. Sensitivity analysis has produced evidence that the lack of statistical results for HIIT is not ascribable to the criterion for separating horizontal from vertical components of intra-industry trade. We have argued that the level of disaggregation adopted here could be a possible reason for that. In the agenda for future research, a comparison of estimates for HIIT conducted at different levels of disaggregation could be useful to evaluate the sensitivity of results to this explanatory factor.

The more robust estimates I have obtained for VIIT suggest that the disaggregation of trade data at the product level (8-digit) is the correct way to test the industry-specific determinants of vertical intra-industry trade. Of course, it is inherently difficult to predict VIIT using cross-sectoral data, because VIIT is an intra-sectoral phenomenon arising from variance in quality within sectors, so we have to try to infer from the regression results the characteristics of sectors which have high quality variance.

The different patterns of VIIT between intra-EU and extra-EU trade are consistent with a Heckscher-Ohlin view of VIIT, and the statistical results make it clear that it is desirable to separate out the two forms of VIIT. However, we have not succeeded in relating the cross-sectoral distribution of the two forms of VIIT consistently to factor-intensity variables. The robust role of capital intensity in the regressions seems to indicate that the more capital intensive sectors simply have less vertical product variety and therefore less vertical intra-product trade.

We have followed GHM in using skill-intensity in the VIIT regressions in place of the horizontal product differentiation variable, but in fact the latter variable seems generally to perform somewhat better in the explanation of the inter-sectoral distribution of VIIT . When VIIT is separately tested in up-market and down-market components, the skill-intensity variable becomes significant but the direction of the link between this variable and vertical intra-industry trade doesn’t emerge unambiguously.

In effect, results indicate that the cross-sectoral role of factor-intensity in the explanation of VIIT does not derive from an HO explanation. Even my innovation of dividing VIIT in up-market and down-market components, in order to improve the specification of the link between vertical intra-industry trade and factor proportion variables, has not worked as I expected.

I have suggested two possible reasons for that: i) a relevant presence in trade flows of vertical disintegration of production; ii) the adoption of a poor geographical disaggregation for UK VIIT.

In the agenda for future research, it would be desirable to improve the interpretation and the robustness of not conclusive results here presented by testing the components of IIT on the basis of trade data in which final goods are separated from intermediate goods (on this regard, statistics on OPT could be employed). In addition, estimates with a better geographical disaggregation would be desirable also. With respect to this aspect, a panel data analysis able to integrate cross-sector and cross-country dimensions of UK VIIT would be optimal to evaluate the role of country-specific effects properly. I am conscious of the importance of geographical disaggregation. But in the present context, the calculation of IIT indices were carried out for each sector without a mechanised procedure (an example of how IIT indices are calculated for each 3-digit NACE sector is reported in Appendix). The extension of the analysis in terms of more disaggregated geographical groupings would have implied a time consuming work not proportioned to the scope of this chapter.

Appendix

Table 1A - Sectors included in the sample

NACE code	Description
2601	Chemical and man-made fibres (25+26)
3110	Foundries
3120	Forging; drop forging, closed dieforging, pressing and stamping
3130	Secondary transformation, treatment and coating of metals
3150	Boilermaking, manufacture of reservoirs, tanks and other sheet-metal containers
3160	Manufature of tools and finished metal goods, except electrical equipment
3210	Manufacture of agricolture machinery and tractors
3220	Manufacture of machine-tools for working metal, and of other tools and equipment for use with machines
3230	Manufacture of textile machinery and accessories; manufacture of sewing machines
3240	Manufacture of machinery for the food, chemical and related industries
3250	Manufacture of plant for mines, the iron and steel industries and foundries, civil engineering and the building trade; manufacture of mechanical handling equipment
3260	Manufacture of transmission equipment for motive power
3270	Manufacture of other machinery and equipment for use in specific branches of industries
3280	Manufacture of other machinery and equipment
3440	Manufacture of telecommunications equipment, electrical and electronic measuring and recording equipment, and electro-medical equ
3450	Manufacture of radio and television receiving sets, sound reproducing and recording equipment and of electronic equipment and apparatus (except electronic computers); manufacture of gramophone records and prerecorded magnetic tapes
3460	Manufacture of domestic type electric appliances
3470	Manufacture of electric lamps and other electric lighting equipment
3510	Manufacture and assembly of motor vehicles (including road tractors) and manufacture of motor vehicle engines
3610	Shipbuilding
3630	Manufacture of cycles, motor-cycles and parts and accessories thereof
3640	Aerospace equipment manufacturing and repairing
3710	Manufacture of measuring, checking and precision instruments and apparatus
3720	Manufacture of medical and surgical equipment and orthopaedic appliances (except orthopaedic footwear)
3730	Manufacture of optical instruments and photographic equipment
4110	Manufactures of vegetables and animal oils and fats
4120	Slaughtering, preparing and preserving of meat (except the butcher's trade)
4130	Manufacture of dairy products
4140	Processing and preserving of fruit and vegetables
4150	Processing and preserving of fish and other sea foods fit for human consumption
4160	Grain milling
4190	Bread and flour confectionery
4200	Sugar manufacturing and refining
4210	Manufature of cocoa, chocolate and sugar confectionery
4220	Manufacture of animal and poultry foods (including fish meal and flour)
4230	Manufacture of other food products
4240	Distilling of ethyl alcohol from fermented materials; spirit distilling and compounding
4250	Manufactures of wine of fresh grapes and of beverage base thereon
4270	Brewing and malting
4280	Manufactures of soft drinks, including the bottling of natural spa waters
4290	Manufacture of tobacco products
4360	Knitting industry
4380	Manufacture of carpets, lineolum and other floor coverings, including leathercloth and similar supported synthetic sheeting
4410	Tanning and dressing of leather
4420	Manufacture of products from leather and leather substitutes
4510	Manufacture of mass-produced footwear (excluding footwear made completely of wood or of rubber)
4530	Manufacture of ready-made clothing and accessories
4550	Manufacture of household textiles and other made-up textile goods (outside weaving-mills)
4610	Sawing and processing of wood
4620	Manufacture of semi-finished wood products
4630	Manufacture of carpentry and joinery components and of parquet flooring
4640	Manufacture of wooden containers
4650	Other wood manufactures (except furniture)
4660	Manufacture of articles of cork and articles of straw and other plainting materials (including basketware and wickerwork); manufacture
4670	Manufacture of wooden furniture
4710	Manufacture of pulp, paper and board
4720	Processing of paper and board
4730	Printing ad allied industries
4810	Manufacture of rabber products
4830	Processing of plastics
4910	Manufacture of articles of jewellery and gold-smith's and silversmith's wares; cutting or otherwise working of precious and semipreciou
4930	Photographic and cinematographic laboratories
4950	Miscellaneous manufacturing industries

Industry data

Industry data is taken from European Commission's INDE database which provides information concerning 80 industrial variables for 12 EU reporting countries (France, Belgium, Luxembourg., Netherlands, FR Germany, Italy, Utd. Kingdom, Ireland, Denmark, Greece, Portugal, Spain). These variables - inter alia - include: number of enterprises, number of manual and non-manual workers, gross wages and salaries, social charges, labour costs, turnover, investments, purchases of intermediate products, gross added value, indirect taxes, bank charges, etc. Industries are coded and described in accordance with NACE. In the present work, I have considered the 63 3-digit NACE sectors reported in table 1A (some sectors were excluded because of missing data) . The description of the industrial variables considered in the analysis is reported in the text (section 4.1)

Trade data

Trade data on the CD-ROM is taken from the EUROSTAT COMEXT database. For 1990 reporting countries are the 12 EU countries already mentioned (where Belgium and Luxembourg together are treated as one). Reporting countries are identified by a geonomenclature code in combination with a validity period. A separate identifier EUR12 is available to refer to the European Communities as a whole.

Partner countries can be within or outside the EU. They are identified by a geonomenclature code in combination with a validity period. This is because the definition of countries may be subject to geopolitical change (the COMEXT database deals, for example, with a country Yugoslavia 65-91 as well as a country Yugoslavia 92-92). Separate identifiers are available to refer to groups of countries, such as the European Union as a whole, the world, and many geopolitical groupings of countries.

Products are coded and described in accordance with the Combined Nomenclature. This nomenclature has 4 hierarchical levels: HS2, HS4, HS6 and CN8. Trade data is available at every level of the nomenclature. In addition to the Combined Nomenclature, the following product nomenclatures may be available: SITC rev.3, Nace-CLIO D, Nimexe, SITC rev.2. The SITC is the standard classification system used by the United Nations Organisation. Revision 2 was in use from 1977 up to and including 1987, revision 3 was adopted in 1988. It is a hierarchical coding system with codes consisting of 1 to 5 digits. The Nace-CLIO D is a non-hierarchical classification used for the European System of Integrated Economic Accounts. It was adopted in 1976, and codes consist of 3 digits. The Nimexe nomenclature was used up to 1 January 1988 and is closely correlated to the Combined Nomenclature. It is a hierarchical system, with product codes consisting of 2, 4, or 6 digits.

Concordances are available to correlate the SITC rev. 3 and the Nace-CLIO D to the Combined Nomenclature, the SITC rev. 2 and the Nace-CLIO D to the Nimexe nomenclature, and the Nace-CLIO D to the SITC.

In this work, I focussed on concordance between CN8 classification and the NACE industrial classification. In other words, data permits to know all 8-digit commodities included in each NACE sector. So it is possible to calculate IIT indices disaggregated at the 8-digit level for each 3-digit NACE sector and to regress them on industrial variables which are identified at the 3-digit NACE level. The total number of commodities included in the 63 sectors considered in the sample is 5401.

Table 2A shows an example of how HIIT, VIIT, $VIIT^{+}$, $VIIT^{-}$ indices are calculated in the case of NACE sector 364 (aerospace equipment manufacturing and repairing). In the first column, the code of the 57 8-digit commodities included in NACE sector 364 are reported. The following 4 columns display trade flows (value and volume of imports, exports). Columns 6 and 7 report unit values for imports and exports (obtained as values/volumes ratio). Columns 8 and 9 select flows vertically differentiated, that is trade in which $\frac{UV_i^x}{UV_i^m} \leq 1-\alpha$ or $\frac{UV_i^x}{UV_i^m} \geq 1+\alpha$, where α =0.2. Columns 10 and 11 select up-market flows only, that is trade of those commodities for which $\frac{UV_i^x}{UV_i^m} \geq 1+\alpha$. GL index for total IIT is calculated on flows reported in columns 2 an 3. GL index for VIIT is computed on flows reported in columns 8 and 9. $VIIT^+$ is measured on flows reported in columns 10 and 11. GL indices for HIIT and $VIIT^-$ are calculated as residual.

Table 2A - Example of Grubel-Lloyd indices calculation from spread sheet - NACE 364

criterion 0.2 products 57

Period : 90-52 JAN - DEC Reporting countries : 006 73-94 UTD. KINGDOM
Partner countries : 1000 58-94 W O R L D
Units : 1000 ECU, Metric Tons

Grubel-Lloyd indices	
G-L	0.59382
G-L V	0.52252
G-L H	0.0713
G-L V+	0.29114
G-L V-	0.23138

Products	Flows				Unit values		Vertical flows		Vertical flows +	
	IMP value	EXP value	IMP vol	EXP vol	IMP UV	EXP UV	IMP	EXP	IMP	EXP
364 ND 88-94	7360171	9504081	7256	8895						
84071010 88-94	3610	2935	48	96	75.2	30.6	3610	2935	0	0
84071090 88-94	3341	3969	74	156	45.1	25.4	3341	3969	0	0
84089010 88-94	291	932	8	64	36.4	14.6	291	932	0	0
84091010 88-94	16711	35005	76	219	219.9	159.8	16711	35005	0	0
84091090 88-94	10358	26583	324	643	32.0	41.3	10358	26583	10358	26583
84111110 88-94	72063	25027	97	80	742.9	312.8	72063	25027	0	0
84111190 88-94	26019	45004	140	111	185.9	405.4	26019	45004	26019	45004
84111211 88-94	100831	14257	119	21	847.3	678.9	0	0	0	0
84111213 88-94	104436	508008	241	878	433.3	578.6	104436	508008	104436	508008
84111219 88-94	302842	1369231	788	2375	384.3	576.5	302842	1369231	302842	1369231
84111290 88-94	247683	64832	696	163	355.9	397.7	0	0	0	0
84112110 88-94	15461	50065	33	106	468.5	472.3	0	0	0	0
84112190 88-94	16028	16099	86	30	186.4	536.6	16028	16099	16028	16099
84112211 88-94	47457	18107	57	54	832.6	335.3	47457	18107	0	0
84112219 88-94	657	1713	4	10	164.3	171.3	0	0	0	0
84112290 88-94	41331	10421	143	45	289.0	231.6	0	0	0	0
84118110 88-94	68146	29679	164	71	415.5	418.0	0	0	0	0
84118190 88-94	71875	88739	284	385	253.1	230.5	0	0	0	0
84118210 88-94	10826	12827	93	108	116.4	118.8	0	0	0	0
84118291 88-94	52963	87676	188	1171	281.7	74.9	52963	87676	0	0
84119190 88-94	562020	342122	1984	1410	283.3	242.6	0	0	0	0
84121010 88-94	754	2963	17	40	44.4	74.1	754	2963	754	2963
84121090 88-94	1468	5980	34	110	43.2	54.4	1468	5980	1468	5980
84123110 88-94	2051	108	4	5	512.8	21.6	2051	108	0	0
84123910 88-94	1174	498	11	7	106.7	71.1	1174	498	0	0
84128091 88-94	4991	228	44	3	113.4	76.0	4991	228	0	0
84129030 88-94	2369	4495	33	83	71.8	54.2	2369	4495	0	0
84798910 88-94	16655	3526	511	86	32.6	41.0	16655	3526	16655	3526
84799010 88-94	14673	4785	955	365	15.4	13.1	0	0	0	0
88011010 88-94	1215	576	1	1	1215	576	1215	576	0	0
88011090 88-94	1482	1537	1	1	1482	1537	0	0	0	0
88019010 88-94	1022	2905	1	1	1022	2905	1022	2905	1022	2905
88019091 88-94	996	6323	1	1	996	6323	996	6323	996	6323
88019099 88-94	55	399	1	1	55	399	55	399	55	399
88021110 88-94	19154	9080	1	1	19154	9080	19154	9080	0	0
88021190 88-94	208	514	1	1	208	514	208	514	208	514
88021210 88-94	47415	15456	1	1	47415	15456	47415	15456	0	0
88021290 88-94	1	115457	1	1	1	115457	1	115457	1	115457
88022010 88-94	17167	18470	1	1	17167	18470	0	0	0	0
88022090 88-94	2064	1579	1	1	2064	1579	2064	1579	0	0
88023010 88-94	153713	513346	1	1	153713	513346	153713	513346	153713	513346
88023090 88-94	10555	592956	1	1	10555	592956	10555	592956	10555	592956
88024010 88-94	3216032	1763620	1	1	3216032	1763620	3216032	1763620	0	0
88024090 88-94	120194	1	1	1	120194	1	120194	1	0	0
88031010 88-94	16475	43354	1	1	16475	43354	16475	43354	16475	43354
88031090 88-94	109234	38122	1	1	109234	38122	109234	38122	0	0
88032010 88-94	31501	113653	1	1	31501	113653	31501	113653	31501	113653
88032090 88-94	17621	18935	1	1	17621	18935	0	0	0	0
88033010 88-94	518314	864786	1	1	518314	864786	518314	864786	518314	864786
88033090 88-94	516108	1125711	1	1	516108	1125711	516108	1125711	516108	1125711
88039010 88-94	127	354	1	1	127	354	127	354	127	354
88039091 88-94	6697	23679	1	1	6697	23679	6697	23679	6697	23679
88039099 88-94	648677	1269617	1	1	648677	1269617	648677	1269617	648677	1269617
88051010 88-94	871	3814	1	1	871	3814.00	871	3814	871	3814
88052010 88-94	58920	149117	1	1	58920	149117	58920	149117	58920	149117
88052090 88-94	25270	34907	1	1	25270	34907	25270	34907	25270	34907
88990000 93-94	1	1	1	1	1	1	0	0	0	0

Table 3A - Descriptive statistics for sample

Variable	Mean value	Standard deviation	Minimum value	Maximum value
SUBSE	85.73	83.62	4.00	365.00
SCA	36.27	108.22	2.37	821.49
COMP	394.41	504.85	6.00	2537.00
SKUN	0.051	0.031	0.018	0.169
KL	0.0045	0.0032	0.0009	0.0146
Total trade				
IIT	0.481	0.200	0.018	0.820
HIIT	0.179	0.135	0.0001	0.547
VIIT	0.302	0.170	0.0015	0.814
VIITUP	0.200	0.140	0.0015	0.688
VIITDO	0.101	0.121	0.0001	0.665
Intra-EU trade				
IIT	0.495	0.191	0.050	0.867
HIIT	0.199	0.138	0.0001	0.692
VIIT	0.295	0.174	0.011	0.682
VIITUP	0.152	0.125	0.0001	0.597
VIITDO	0.142	0.134	0.0001	0.548
Extra-EU trade				
IIT	0.349	0.211	0.004	0.720
HIIT	0.086	0.099	0.0001	0.514
VIIT	0.263	0.174	0.0005	0.720
VIITUP	0.188	0.139	0.0001	0.669
VIITDO	0.075	0.102	0.0001	0.495

Chapter 3: The impact of international trade on labour markets in the presence of vertical product differentiation

1. Introduction

In the last two decades macroeconomists and labour economists have provided an explanation of unemployment in OECD countries in terms of institutional rigidity and hysteresis. In the mid-1990 the permanence of high levels of unemployment, after a long period of labour market deregulation and after the substantial reabsorption of hysteretical effects associated with oil-shocks, has made the explanation above mentioned much less persuasive. Hence the search for a new answer. A recent attempt at giving a rationale of the unfavourable evolution of labour markets in advanced countries focuses on the shift in demand away from unskilled labour. While the outcomes of this shift seem to be relatively uncontroversial (growing inequality in USA and UK and sharpening unemployment in European well-regulated labour markets)[21] the causes are strongly debated. The two most preferred explanations are technological change and international trade, the latter also justified by the increasing trade liberalization between industrially more advanced economies and less developed ones.

Although there may be interaction between trade and technology, the recent academic debate has principally considered them as alternative explanations. There is an easy and natural association between the stylised facts and the traditional Heckscher-Ohlin-Samuelson model of international trade (henceforth HOS). That model predicts a strong link between trade flows and income differentials: the opening of international trade between countries with different endowments of human skills leads to a decline in the relative wages of unskilled workers in the more developed countries (or to unemployment, in the case of advanced economies with strong institutional rigidities in wage setting).

However, the majority of academic opinion does not believe that the labour market impact in developed countries of trade with developing countries is particularly important. Trade theorists especially have denied the evidence of a strong link between trade and labour markets - see, *inter alia*, Lawrence and Slaughter (1993) and Krugman and Lawrence (1994). At first sight this position could seem paradoxical, as Freeman (1995) has noted, but it turns out to be quite reasonable when all the implications of the HOS model are rigorously compared with the empirical evidence, beyond the comfortable association between some stylised facts and the main predictions of the theory. In effect, if we look carefully at the chain of causation postulated by the HOS model we can identify three steps: 1) increasing exports of unskilled-intensive goods by developing countries push down the price of these goods in developed countries, inducing a decline in the relative wage of unskilled labour (the Stolper-Samuelson theorem), thereby 2) causing substitution in production towards unskilled labour, and 3) maintaining full employment by inter-sectoral substitution of production towards more skill-intensive products.

When we compare this theoretical story with empirical evidence some inconsistencies appear: 1) the positive one to one relationship between prices and wages, so crucial in

[21] Nevertheless some authors cast doubt on the supposed trade-off between wage flexibility and unemployment. See Freeman (1995), Nickell and Bell (1996), Gregg and Manning (1997).

the HOS framework, is not fully confirmed by the data[22]; 2) instead of a lower skilled/unskilled ratio, empirical evidence shows the adoption by firms of a higher ratio in all sectors[23]; 3) no evidence of substantial inter-sectoral movement of production emerges in advanced countries. Lawrence and Slaughter (1993) have remarked on these three discrepancies between the HOS predictions and empirical evidence with reference to the United States. Furthermore the observation that the great bulk of world trade (also North-South trade) is characterised by intra-industry flows makes the adoption of the HOS framework less plausible[24].

All these reasons have progressively weakened the trade-based explanation of unskilled-adverse change in labour demand and the emphasis has shifted to wage inequality as resulting from skill-biased technological change[25]. However, the role of trade effect may be too quickly dismissed insomuch as it is universally identified with the HOS story without any attempt to turn to an alternative analytical framework. In the end, the recourse to skill-biased technological change is seen by Johnson (1997) as something of a tautology[26].

Adrian Wood contrasts the prevailing idea among economists that the rising strains on unskilled labour in developed countries are driven by technological change rather than international trade. Wood (1994) uses an HOS-type framework and focuses on the effect of trade on employment. He calculates that the displacement effects of North-South trade on unskilled labour demand in developed countries have been very pronounced: ten times the number of jobs have been lost than estimated by previous studies on the employment effects of trade. A key point made by Wood is that the South's exports to the North are *non-competing*. In other words, the goods exported by developing countries are different from the North's products, even if they belong to the same statistical class. Previous studies have not considered this aspect and have underestimated the unskilled labour content of Northern imports from the South and therefore have undervalued the impact of trade on unskilled workers in advanced countries. The work of Adrian Wood warns against the risk of understating the effects of trade on labour markets if product heterogeneity is not adequately examined.

This chapter follows Wood and reconsiders the importance of the labour market effects of international trade in the light of *non-competing* trade. Specifically, the chapter addresses two forms of *non-competing* trade: trade which is intra-industry but inter-product, and intra-industry trade with vertical product differentiation, where products differ in quality levels. In neither case, will the impact of IIT on labour markets be neutral. Specifically, with vertical IIT (VIIT) it is reasonable to suppose that differences in quality are associated with differences in skill content, so that high (low) quality products incorporate high (low) content of skilled labour. In this case trade among countries with different endowments of human skills induces movements of specialization along the quality spectrum for each sector. In other words, trade induces factor substitution *within* sectors at the level of individual products where factors are related to human capital, skills and knowledge, including firm-specific knowledge. This is a treatment of IIT within the HOS tradition, but in contrast with the traditional HOS model of inter-industry trade.

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22 While Lawrence and Slaughter find no evidence of relative price changes in the USA, Sachs and Shatz (1994) observe some relative price variations.

23 Krugman and Lawrence (1994) provide evidence that at the 2 digit level of sectoral aggregation the increase in the relative wages of skilled workers (proxied by non-production workers) has been associated with a rise in the relative employment of skilled workers. Lawrence and Slaughter (1993) confirm this positive relationship at the 3 and 4 digit levels of aggregation.

24 See Krugman (1994).

25 See the recent symposium in *Journal of Economic Perspectives*, Spring 1997

26 "Admittedly, the preliminary conclusion that technological change caused the relative demand shifts was somewhat tautological: a) it must have been X_1, X_2 or X_3; b). it was not X_2 or X_3;c) ergo, it was X_1", Johnson (1997) , *Journal of Economic Perspectives*, Spring , p.47.

We shall see that it is more consistent with the stylised facts about trade and labour markets.

This chapter applies this new perspective to the Italian case, which is taken here as an example of the methodological approach for which quantitative evidence is provided. The study of the implications of vertical IIT for labour markets is particularly pertinent to Italy. In fact, given that the international specialisation of the Italian economy is strongly oriented towards traditional consumption goods, the impact of international trade with less advanced countries (henceforth LACs) on the Italian labour market is underestimated if vertical product differentiation is not considered adequately.

This chapter is structured in five sections. The next section offers a short survey of the literature on trade and labour markets in order to have a general picture in which my methodological approach could be located.

Section Three provides an analytical model to focus on the theoretical implications of vertical product differentiation for the labour market effects of international trade.

Section Four first offers empirical evidence on Italian trade flows, identifying the share of trade flows that are likely to have an impact on the labour market. It then provides a method of inferring factor content of intra-industry trade from inter-industry relationship between factor intensity and average unit values of exports. It shows empirically that the labour market effects of IIT are a relevant fraction of the total impact of trade. The final section contains some concluding remarks.

2. Trade and labour markets: an overview of the literature

A more accurate understanding of results achieved in this chapter calls for a wider comparison with alternative approaches followed in the studies on trade and labour markets. In the last ten years the literature on trade and wages has expanded a great deal and it is not easy to give full account of all contributions. A sensible task to undertake in the present context is to consider the most representative works of each approach in order to underline similarities and differences with the analysis here reported.

Following Slaughter (1998) and Greenaway and Nelson (2001), I adopt a fourfold classification of contributions: i) simple evaluation of consistency between data and standard theory of international trade (HOS model and SS theorem); ii) FCT studies; iii) mandated-wage regressions; iv) CGE studies.

2.1 Simple evaluation of consistency with theory

At the beginning of the 1990s, labour economists especially suggested the relevance of international trade in explaining the rising skill premium in labour markets of advanced countries (see Murphy and Welch, 1991, and Borjas, Freeman and Katz, 1992, *inter alia)*. The response of trade theorists was to check for conformity of the empirical evidence with the theory, almost universally identified with the HOS framework. Lawrence and Slaughter (1993), Bhagwati and Dehejia (1994) and Sachs and Shatz (1994) were early studies testing the coherence between data and HOS mechanism.

In the introductory section of this chapter the important contribution of Lawrence and Slaughter (1993), checking for the consistency of the United States data with Stolper-Samuelson chain of causation, has been already mentioned. Firstly Lawrence and Slaughter checked for the adjustment postulated by SS story: a decline in the ratio of skilled to unskilled workers in manufacturing. They found a pervasive *rise* in the ratio of non-production to production workers in industries at the two-digit level and at the four-digit level as well[27]. From this preliminary observation they concluded that the Stolper-Samuelson effect was nonexistent or obscured by a larger effect (technological change). For this reason, in order to determine the *size* of the Stolper-Samuelson effect, they proceeded to examine international prices. Here too, data suggested that the Stolper-Samuelson mechanism did not affect American relative wages in the 1980s.

Bhagwati and Dehejia (1994) also contested the plausibility of HOS framework in explaining the worsening of American unskilled wages. Preliminarily they remarked the unrealistic assumptions that underlie the Factor Price Equalization theorem. These hypotheses deny the existence of conditions very common in real world: reversals of factor intensities, differences in technology, scale economies, X-efficiency effects, etc; all circumstances that allow a positive welfare effect of international trade on both factors. Then the authors, by looking at empirical evidence available from other studies (Lawrence and Slaughter, 1993, *inter alia*), emphasized the absence of a coherent link between factor prices and good prices. From this evidence, they dismissed the Stolper-Samuelson mechanism as an adequate guide to reality and suggested an alternative framework. In their model, comparative advantages are assumed to become volatile in an increasingly integrated world economy ('kaleidoscopic' comparative advantages). This volatility in comparative advantage will increase labour turnover with the consequence of depressing the growth of earnings, given that more mobile workers could be acquiring less skills: "…a rolling stone gathers no moss and a moving worker gathers no skill" (Bhagwati, 1991). This argument applies asymmetrically to labour force: unskilled workers are more vulnerable for the reason that their workplace-acquired skills are less transferable in comparison with skills accumulated by more educated workers. In conclusion, as showed, Bhagwati and Dehejia (1994) suggested an alternative theoretical way in which international trade may affect wages but they didn't offer an original empirical analysis to test their model.

On the contrary, Sachs and Shatz (1994) offered a very comprehensive piece of empirical analysis, part of which will be discussed in next subsection as a FCT study. They started by classifying 131 3-digit manufacturing sectors according to the skill intensity of production and measuring the net trade balance relative to total trade flows. They found a preliminary corroboration of the basic HOS proposition: with developing countries the United States tended to be a net exporter of skill intensive products and a large net importer of non-skill-intensive products (in 1990). This result was reinforced when Sachs and Shatz regressed the Grubel-Lloyd index on the wage of country j relative to the U.S. wage for 1990: low-wage countries have much more inter-industry trade with the Unites States than do high-wage countries. According to Sachs and Shatz, also the evidence concerning price changes would suggest the validation of HOS story. By using domestic price deflators from U.S. Bureau of Economic Analysis at the 3-digit level instead of import and export price indexes used by Laurence and Slaughter, Sachs and Shatz found that the relative price of non-skill-intensive goods *fell* during the 1980s. Although the data set used by Sachs and Shatz covers a larger number of industries in comparison with Lawrence and Slaughter data, we still have to consider the general question of whether relative sectoral price changes are reliable signals of the trade impact in the presence of quality differentiation. According to the analytical framework here offered they don't : the rise in the skill premium in the North will raise the relative price of skill-intensive product varieties but will have weak and uncertain effects on relative sectoral price indices.

[27] In American studies on trade and labour markets, the characterization of labour skills is based on the distinction between production and non-production workers.

2.2 Factor content of trade studies

The core of the contribution of Sachs and Shatz (1994) was a factor content of trade analysis applied to the United States in the period 1978-1990 by using 51 manufacturing sectors (according to the 2-digit input-output matrix calculated by the Department of Commerce). The *factor content of trade* (FCT) methodology involves the calculation of the amount of skill, labour, and capital incorporated in trade flows in order to estimate the impact of trade on factor demand. Assuming that a unity of output is equivalent to a unity of exports (imports), the factor content of exports (imports) is calculated multiplying the matrix of coefficients - specifying the quantity of each factor used per unity of output in each sector - by the vector of sectoral exports (imports). The net effect of trade on factor demand is calculated as the difference between the factor content of exports and that of imports. Sachs and Shatz (1994) carried out a FCT analysis for the US, by postulating a counter-factual case in which the ratio of net imports to final demand didn't increase after 1978. For an unchanged level of final demand in 1990, they considered the additional employment resulting from the counterfactual assumption as the estimated loss of jobs induced by the fast rise of net imports in the period. They found that 5.9 percent of total manufacturing employment was displaced by total trade (relative to 1978 employment levels). Production workers were especially damaged by trade (-7.2%) in comparison with non-production workers (2.1%). The loss of unskilled employment (production workers) was almost entirely caused by trade with developing countries (-6.2%). As remarked by Sachs and Shatz, these numbers are not trivial: international trade accounts for about 39% of the total decline of U.S. manufacturing employment in the period 1978-90. Although the analysis of Sachs and Shatz was remarkable for the richness of data used (disaggregated by sectors and trading partners) and for the completeness to the exposition, it was a conventional FCT study and not particularly innovative in comparison with the standard technique used by labour economists.

On the contrary, the contribution of Adrian Wood represented a substantial departure from the tradition of FCT calculations. In the introduction of the present chapter, the essential message of Wood's book on trade and labour markets has been already mentioned: the South's exports to the North are *non competing* and if this non-competition is not adequately considered, the displacement effect of North-South trade on unskilled labour demand in the developed countries will be underestimated. In effect, according to Wood, standard FCT studies systematically underestimated unskilled labour content of South exports to the North because they used the factorial coefficients matrix of developed countries as estimators of production techniques of the South. In order to correct this underestimation of unskilled labour content of North's import from the South, Wood suggested the use of input-output matrix of the South. By using the input-output table of South Korea as the benchmark for the South's productions, Wood calculated the impact of North-South trade on unskilled labour demand in the developed countries, and he concluded that a much larger number of jobs had been lost than estimated by previous studies. The following table offers a comparison between Wood's and Sachs and Shatz's results.

Factor content of trade studies. Estimates of the impact of North-South trade on the labour markets of advanced countries. A comparison.

Impact on	*Sachs and Shatz*	*Wood*
Total employment	-5.7%	-10.8%
Skilled labour	-4.3%	0.3%
Unskilled labour	-6.2%	-21.5%
Relative demand of unskilled labour	-1.9%	-21.8%

Source: Sachs and Shatz (1994), Wood (1994)

Although there are many differences in data and definition of variables between Wood's and Sachs and Shatz's works[28], nevertheless it is evident that the impact of trade on labour markets turns to be much stronger when FCT calculations are modified to take account of non competing trade: in Wood's calculation, the negative effect of trade on total employment doubles and the adverse impact on relative demand for unskilled labour increases more than tenfold. In the present chapter, as we will see, the key idea of non-competing trade suggested by Wood has been pursued by implementing a methodology able to capture the role of heterogeneity in intra-industry trade. In accordance with Wood's results, the analysis of this chapter will demonstrate that an FCT calculation of the trade effect on labour markets is significant larger when the product heterogeneity is adequately allowed for.

2.3 Criticisms of FCT approach and mandated-wage regressions

However, the FCT methodology has been questioned by many authors for several reasons. Freeman (1995), for example, stressed the reaction of wages to the threat of import penetration. In other words, according to Freeman, looking only at trade volumes (as in FCT studies) could be misleading because the adjustment of wages to international competition in advanced countries could limit the growth of imports from less advanced countries *ex ante*. In this case, FCT calculations would underestimate the pressure of international trade on labour markets. In some way, this argument based on the idea of "defensive wages" resembles the Wood's notion of "defensive innovation", according to which the North has reacted to Southern competition by adopting new production techniques that use less unskilled labour. Both lines of reasoning reinforce the idea of a stronger global impact of trade on labour markets as a result of the indirect effects of trade. From this perspective, FCT calculations would produce only a measure of the minimum impact of trade impact, but would still represent a plausible attempt to give a

[28]Whereas Wood considers all advanced countries, Sachs and Shatz focus their analysis on USA. Also the classification of workers is different. In the case of Sachs and Shatz, workers are distinguished according to the type of job: production and nonproduction labour. In the case of Wood, the differentiation of workers is based on the years of education and experience. Finally also counterfactual hypotheses are different: Wood assumes absence of trade, whereas Sachs and Shatz suppose that the ratio of imports to output was fixed to the 1978 level.

rough dimension to the phenomenon, given that is very difficult to incorporate in the empirical analysis some missing elements such as defensive innovation of "defensive wages".

Another general criticism of FCT calculations has been offered by Deardorff and Hakura (1994). They put emphasis on the problem of causality: is the growth of Northern net imports from the South induced by exogenous factors or are internal causes more relevant? FCT studies implicitly or explicitly assume that the increase of the trade flows between the North and the South is driven by exogenous changes: reduction of trade barriers, technical progress, increasing level of education or capital accumulation in the South. But if the growth of net imports in USA or in Europe was mainly due to internal factors not considered in the FCT analysis - like a macroeconomic expansion, a rising propensity to expenditure of individuals or technical progress in the North - then it would be hard to identify international competition with less advanced countries as the *cause* of the tensions in the labour markets of advanced countries.

The critical observations of Freeman (1995) and Deardorff and Hakura (1994) on the FCT approach remarked some crucial missing element in the empirical analysis. However, they did not provided any alternative framework. A more radical criticism of FCT calculations was expressed on the ground of the theory, with the proposal of an alternative methodological approach. In the standard model of international trade (the HOS framework and SS theorem) the direct link between prices and wages is crucial to understand the impact of trade on labour markets. But the FCT approach takes in account only trade volumes without any consideration of the relationship between factor remunerations and prices. For this reason, some authors suggested an alternative approach more entrenched in the tradition of trade theory; this method was based on mandated-wage regressions. It originated from the Jones (1965, 1977) demonstration that the change in the price of a good will be equal to a factor share weighted average of change in factor prices:

$$\hat{p}_i = \sum_k \hat{w}_k \theta_{ik}$$

where $\hat{p}_i$ is the proportionate price change in product *i*, $\hat{w}_k$ is the proportionate price change in factor *k* and θ_{ik} is the beginning-period factor share[29]. Jones equation was applied to the measurement of production cost differences across countries by Baldwin and Hilton (1984), Hilton (1984); and more recently Leamer (1995, 1998) and Baldwin and Cain (2000) have utilized the Jones decomposition to study the wage differentials between skilled and unskilled in the United States. In particular, Leamer extended Jones equation to take account of technical change:

$$\hat{p}_i = \sum_k \hat{w}_k \theta_{ik} - T\hat{F}P_i$$

where $T\hat{F}P_i$ is the proportionate change in total factor productivity in sector *i*. Essentially, this "mandated-wage regressions" method built on the Jones-Baldwin framework interprets the estimated coefficients on the factor shares in equation as the *"mandated"* changes in factor costs $\hat{w}$ that are compatible with the zero-profit condition in the presence of changes in product prices and technology. A comparison between mandated wage changes and actual ones should indicate if price changes are driven by globalisation or, alternatively, technological change are an accurate explanation of the trends in wages.

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29 $\theta_{ik} = \frac{a_{ik} w_k}{p_i}$, where a_{ik} is the amount of factor *k* used per unit output of commodity *i*.

From a data set of 450 four-digit SIC industries offering information about price changes, TFP growth and beginning-period factor shares, Leamer (1998) carried out mandated-wage regressions in the case of U.S. in the period 1961-1991 and found that: i) globalisation effect dominated technology effect; ii) in the seventies price changes driven by globalisation have widen the wage differential between skilled and unskilled, while in the eighties they have reduced the inequality. Baldwin and Caine (2000) roughly adopted the same methodology of Leamer but with the use of international prices instead of domestic prices and found opposite results: i) during the seventies the wage gap among workers of different education levels narrowed, especially for the increase in the relative supply of more educated; ii) from 1980 to 1993 the previous trend reversed and the sharp widening of wage gap was not due to import competition but was mainly caused by technological change. How to interpret this big divergence in empirical results? Apparently, although mandated-wage regressions approach seems to be more conforming to the standard theory of international trade, problems in the treatment of data still remain. Davis, in his comment to Leamer's work (1998), has underlined the scepticism of labour economists about a significant covariance between relative wage changes and product price movements, beyond the fact that the link between prices and wages emphasized by trade theorists is not intrinsically international. In addition, the general recommendation of evaluating the role of heterogeneity is also indicated when price movements are analysed. Furthermore, the treatment of technological change in Leamer's work does not allow any role of *factor-biased* technological progress in affecting product prices and factor prices, while this factor represents the main challenging hypothesis against the trade-based explanation of the decline in relative wages of American unskilled workers.

2.4 CGE studies

The various studies on trade and labour markets examined so far are partial equilibrium approaches: trade flows with less developed countries or price changes generated by those flows - and related to movements in wages or employment levels in labour markets of advanced countries - are assumed as *given* . In other words, those studies omit in the analysis the fundamental circumstance that the remunerations of factors and their employ are *simultaneously* determined with price, production and consumption levels in the economy, other than the volume of traded goods. This circumstance calls for an approach of general equilibrium.

Among contributions which explore the effects of trade on labour markets by following a general equilibrium approach, we can distinguish two lines of research. On the one hand, analyses based on computational general equilibrium (CGE) models of large dimensionality built for other purposes but also utilized to simulate the relationship between trade shocks and labour markets. On the other hand, very simple general equilibrium models of low dimensionality which do not estimate the impact of trade on labour markets properly but offer a broad stylisation of facts with a rough evaluation of trade effects through the use of parameters borrowed from other empirical studies.

An example of CGE model of small dimension is offered by Krugman (1995). Substantially, Krugman adopts a HOS-type structure of the economy: 2 trading partners (the OECD and the NIE, the group of newly industrializing economies), 2 goods (a skill-intensive good and a less skill-intensive good), 2 factors (skilled and unskilled labour). The basic hypotheses are those of perfect competition, constant return to scale, homothetic preferences, but occasionally Krugman departs from them. For example, he assumes that the OECD fixes the equilibrium prices of goods exported by less advanced countries for the reason that modelling the OECD as a small country which faces given international prices would be deeply unrealistic. Krugman assigns particular values to the parameters which characterize OECD economy on the basis of numbers derived from

Wood's work (relative wages, skilled/unskilled ratio in each industry, share of each good on total expenditure, etc.) and then applies the model by testing two hypotheses: a "European" context with rigid wages and an "American" context with flexible wages.

In the first case, the opening of international trade between the OECD and the NIE generates in the OECD economy the usual HOS chain of causation but with the difference that now the adjustment does not involve price changes but just quantity changes and in the end unskilled workers are hurt in terms of unemployment instead of declining wages. In fact, in the OECD, the surplus of unskilled workers caused by the trade-driven inter-sectoral substitution of production towards more skill-intensive products will be not absorbed by a decline in relative wages but just by a rise in unemployment (under the hypotheses that the OECD has market power relative to the NIE and wages are rigid in the OECD). In the end, if the process of adjustment described so far was exhaustive, the impact of trade on labour market could be easily estimated in terms of factor content of net imports, but, according to Krugman, that story is not conclusive.

In fact, the adjustment includes an additional element: an income effect. When unemployment emerges, the total income of the economy decreases and this involves a declining demand for both goods and for both factors. But, in the case of skilled labour the drop of demand is compensated by the positive effect induced by trade, while in the case of unskilled labour the fall of demand is aggravated by the unskilled-adverse shift in labour demand induced by trade. Krugman, through diagrams, shows clearly that in the OECD the increase of skill-intensive production is smaller than the growth of corresponding exports, while the decline of unskilled-intensive output is bigger than the rise of imports. This implies that in the OECD the unskilled unemployment generated by the OECD trade with the NIE is bigger than the unskilled labour content of net imports. In other words, the original impact of trade on labour market is amplified by a *general-equilibrium multiplier effect*.

The "American" case explored by Krugman is more standard than the "European" approach described above and does not need particular comments because it incorporates the same chain of causation and the same result postulated by Stolper-Samuelson theorem: the opening of international trade between countries with different endowments of human skills leads to a decline in the relative wages of unskilled workers in the more developed countries.

In terms of simulation, it is interesting to note that the same model predicts a relevant effect on unemployment when the "European" version is tested: 1.5 percentage points increase, which is not a trivial number; but a small effect on wages when the "American" approach is tested: a 3% increase of skilled relative wages, which is less than the actual change in the skill differential, would be associated with a 2.2% share of imports from NIE in OECD product, which is more than the actual penetration of the NIE in OECD markets.

Francois and Nelson (1998) also provide a low dimension CGE model. They start from a simple HOS framework and then introduce two alternative assumptions about the production structure of the economy: inter-sectoral links between industries, and product differentiation. Under the first hypothesis, the Stolper-Samuelson effect is amplified but under the second both factors could gain from trade. Thus the HOS model is adaptable to take account of new considerations, but once it is so adapted its results become more variable.

An example of large dimension CGE model is offered by Smith (1999). In his work, Smith adopts a level of disaggregation which is deeper in comparison with the level normally used in CGE analysis: 64 sectors at the 3-digit level according to the NACE classification. The structure of the model is characterized by 12 countries (the 1991 EU countries and the rest of the world as a whole); each country is endowed with three factors: capital (internationally mobile), skilled labour and unskilled labour (proxied by non-manual and manual labour; both of them internationally immobile); each manufacturing industry is modelled as an imperfectly competitive market in which firms produce differentiated products under increasing returns to scale; the demand side of the model is based on Dixit and Stiglitz's (1977) two-stage mechanism in which the consumer's demand for a product aggregate depends on the price index for that aggregate, while the demand for a specific variety depend on the price of variety relative to the price index. Beyond some key standard parameters derived from literature estimates (demand elasticity), the numerical calibration of the model is completed by selecting other important industry-specific parameters such as shares in value added, sectoral concentration and returns to scale indices in order to fit the model to a base dataset

Under the common hypothesis that all EU trade with non-advanced countries (NACs) ceases, three alternative simulations are carried out by Smith: i) a calculation of trade effects in terms of change in factor demand, with no price adjustment in either goods or factor markets (*de facto*, a standard FCT calculation); ii) a CGE calculation with goods market clearing but without factor price adjustment (implying the adjustment of intra-EU trade flows to absorb the initial trade shock, and the adjustment in consumption and production to the change in good prices); iii) a CGE calculation with factor market clearing.

In all three experiments the impact of trade is small: i) in the first simulation, the demand for non-manual workers relative to manual workers is fostered by trade with NACs between 0.4 and 0.7 per cent only; ii) in the second simulation, for many of the EU countries (especially the larger economies), the CGE effects of the initial trade shock are very similar to those obtained in the FCT calculation; iii) in the last simulation, the change in relative wages of non-manual workers do not exceed 0.5 %.

How to interpret these results? Smith is sceptical about whether these results are sufficient to tell us the real story about the labour market effects of trade. His doubts do not concern CGE methodology by itself. On the contrary, CGE analysis is a versatile instrument able to carry out different types of simulations within one model and to clarify the relationship between approaches considered as dichotomical in the literature (for example FCT approach and the approach looking at the link between relative wages and the prices of traded goods). Furthermore, CGE analysis allows to deal with the problem of causality (already discussed) by formulating explicit hypotheses about exogeneity. So, according to Smith, the lack of convincing results about the link between trade and labour markets has not to be imputed to CGE methodology but to another reason. By looking at the 3-digit sectoral data used in the model, Smith observes that the skill intensity (proxied by the relative shares of manual and non-manual labour in value added) varies across sectors very slightly and EU-NAC trade shows a consistent degree of intra-industry trade. This evidence explains arithmetically why the impact of trade on labour market is so modest: intra-industry trade, by definition, has no labour market effects and inter-industry trade, with all sector having rather similar input proportions, has limited impact on labour markets. This suggest that any calculation (whether of FCT o of GCE) based on the level of disaggregation and on the kind of data used in the model (the 3-digit level) will produce small labour market effects inevitably. Smith concludes that the level of aggregation is an important issue which it is worth to explore in order to improve the treatment of skill intensity and of intra-industry trade as trade in products that are identical in their method of production. A careful consideration of this aspect is crucial for an adequate evaluation of labour markets effects of international trade. The following discussion aims to demonstrate this point.

3. Product quality, intra-industry trade and labour market effects: an analytical framework

3.1 Introduction

IIT among developed countries is still the most important share of world trade, and an increasing proportion of North-South trade is assuming the form of IIT. In the recent debate on globalisation and labour markets, this has been one of the most striking arguments advanced by those who dispute the importance of trade in the growing pressures on less-skilled labour forces in developed economies.

Given that the substituting and distributive effects of IIT are believed to be less severe than those associated with inter-industry trade, this evidence also leads to the conclusion that the recent unfavourable pressure on unskilled labour in developed countries is due to technological change rather than to international trade.

The idea of painlessness associated with IIT dynamics is crucial in the above argument. This idea is so entrenched among international economists because most of the literature on intra-industry trade tends to assume that product differentiation is a phenomenon of a horizontal character; that this to say, it is differentiation based on the attributes of a product in a given quality level rather than on differences in quality levels.[30] Under this view, countries with similar factor endowments and similar (high) income levels exchange distinct varieties of the same product: if expanding and contracting productions show similar factor intensities (in an IIT setting), resource reallocation between them will be easier and wage and price adjustment smaller.

However, the idea of painlessness associated with IIT dynamics becomes weaker if the product differentiation is vertical, that is to say, if products differ in quality. The assumption of factor content similarity between all goods in the same industries is less plausible in a context of VIIT, where it is quite probable that differences in product quality imply differences in factor content. The growing importance of IIT in trade flows between advanced nations and developing countries has prompted a rethinking of the usual image of IIT as two-way trade in horizontally differentiated products and has stimulated the development of models of vertical intra-industry trade.

3.2 The model

As discussed in the previous chapter, an example of a vertical IIT model based on factor proportions is provided by Falvey (1981) and Falvey and Kierzkowski (1985, henceforth FK). The model presented here is closely related to the FK model but with three adaptations.

First, in the FK model each quality is associated with a particular capital-labour ratio. But here quality is related to skill-intensity rather than capital-intensity. Secondly, the model has a continuum of varieties differentiated by quality, with skill intensity positively related to quality. The production side of the model is thus a multi-sector version of that used by Feenstra and Hanson (1996) to model the effects of capital flows. The third variation from the FK model is that product varieties enter the utility function in a symmetrical fashion: all the vertical product differentiation is on the production side. In the spirit of the Heckscher-Ohlin model, it is assumed that consumer tastes are the same in

[30] The reason why the horizontal differentiation paradigm prevails in the IIT literature is that intra-industry trade has generally been represented as a pattern of trade peculiar to developed countries, that is, two-way trade between economies similar in technology, factor endowments and (high) income levels. Empirical evidence provides quite broad support for this image. From a theoretical point of view, the availability of a malleable device like the Chamberlinian monopolistic competition model has also contributed to the explanation of IIT in terms of horizontal product differentiation.

different countries. With free trade, therefore, the same distribution of products and of product varieties enters consumption in all countries. This modification of the FK and Feenstra-Hanson models is due to Smith (1996) and the presentation of the model in the next section is based very closely on his exposition.

In this framework, skill-abundant countries move along the quality spectrum in each sector with respect to less skill-abundant countries, the result being intra-industry specialization with labour market effects. In principle, the model could be adapted to offer a more sophisticated treatment of the skill-intensity of production, but the current version has two types of labour, manual and non-manual proxying for unskilled and skilled labour. The model explains both intra-industry trade and inter-industry trade as deriving from factor endowment differences between countries. It implies that trade will affect inequality, and the properties of the model are consistent with the three stylised facts which Lawrence and Slaughter use to dismiss the Stolper-Samuelson explanation of American wage change.

3.2.1 Demand

The focus of the model is on quality differentiation in production, so the demand side is based on the simplest model of demand for differentiated products, a version of the Dixit-Stiglitz (1977) model, in which it is assumed that there is a continuum of varieties of each good, and that consumer preferences can be represented by a two-stage utility structure.

Suppose that there is a continuum of varieties of product X_i, and that aggregate consumption of the product can be represented by the sub-utility function

$$X_i = \left(\int_0^b a_i(v)^{\frac{1}{\varepsilon}} x_i(v)^{\frac{\varepsilon-1}{\varepsilon}} dv\right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{1}$$

where $\varepsilon > 1$. The price index (unit cost function) representing the cost of producing a single unit of X_i is then given by

$$P_i = \left(\int_0^b a_i(v) p_i(v)^{1-\varepsilon} dv\right)^{\frac{1}{1-\varepsilon}} \tag{2}$$

where $p_i(v)$ is the price of variety $x_i(v)$, and the demand for an individual variety is

$$x_i(v) = a_i(v)\left(\frac{p_i(v)}{P_i}\right)^{-\varepsilon} X_i \tag{3}$$

so ε is the elasticity of demand for a variety with respect to its price relative to the price index of the product group. There is no loss of generality is assuming that the product range [0,b] is the same for every product group *i*, while the assumption that ε is independent of *i* could easily be relaxed.

The aggregate cost of all varieties of this product group is

$$\int_0^b p_i(v) x_i(v) dv = P_i X_i \tag{4}$$

If there are *n* such product groups and upper-level preferences across product groups are Cobb-Douglas, with product group X_i having a share α_i of total expenditure m, the demand function (2) for an individual variety becomes

$$x_i(v) = \alpha_i a_i(v) p_i(v)^{-\varepsilon} P_i^{\varepsilon-1} m \tag{5}$$

3.2.2 Supply

Production of each variety requires both skilled and unskilled labour. Let the unit cost of production of variety v of product i in country j be

$$c_{ij}(v) = \min\{w_{sj}s_i(v) + w_{uj}u_i(v) \mid f_i(s_i(v), u_i(v)) = 1\} \tag{6}$$

where $s_i(v)$ and $u_i(v)$ are the input requirements of skilled and unskilled labour respectively and where the unit production function f_i shows the substitution possibilities for producing variety *i*. The chosen input coefficients will depend on relative wages, which can be indicated simply by writing

$$c_{ij}(v) = w_{sj}s_{ij}(v) + w_{uj}u_{ij}(v) \tag{7}$$

With Chamberlinian monopolistic competition, in which firms ignore the impact of their decisions on the aggregate price index, firms will set prices as a fixed mark-up over marginal cost and a product variety will be supplied by the lowest cost producer, so

$$p_i(v)\left(1 - \frac{1}{\varepsilon}\right) = \min_j c_{ij}(v) \tag{8}$$

and the number of firms producing varieties of the product will in a free-entry equilibrium depend on the level of fixed costs.

3.2.3 Trade

If product varieties are arranged on the spectrum [0,*b*] in order of skill intensity, then countries will specialise in different parts of the spectrum, depending on their ratios of skilled to unskilled wages. If $s_i(v)/u_i(v)$ is increasing in *v*, and if there are two countries, with

$$w_{s1}/w_{u1} > w_{s2}/w_{u2} \tag{9}$$

so country 2 is the skill-abundant country, then from (6) it follows that

$$\frac{s_{i1}(v)}{u_{i1}(v)} < \frac{s_{i2}(v)}{u_{i2}(v)} \quad \text{for all i,v} \tag{10}$$

Suppose now that there is some variety v_i^* of product i which is produced in both countries, so that,

$$w_{s1}s_i(v^*) + w_{u1}u_i(v^*) = w_{s2}s_i(v^*) + w_{u2}u_i(v^*) \tag{11}$$

then Figure 1 shows that, if factor-intensity reversals in the ranking of varieties are ruled out, country 2, the skill-abundant country, will produce only varieties $v \geq v_i^*$, while country 1 will produce varieties $v \leq v_i^*$. Clearly $w_{s1} > w_{s2}$ and $w_{u1} < w_{u2}$, though it is easy to modify the model to introduce international differences in technology, and if the skill-abundant country had a technical advantage, whether neutral or skill-augmenting, that would obviously permit both wages to be higher in that country.

Now consider product *h* which is less skill-intensive than product *i* so

$$\frac{s_{ij}(v)}{u_{ij}(v)} > \frac{s_{hj}(v)}{u_{hj}(v)} \quad \text{for all } v \text{ and for } j = 1,2 \tag{12}$$

so now we are ruling out factor-intensity reversals in the ranking of products and also assuming that the factor-intensity ranking of products holds across the quality spectrum.

Figure 1: Choice of technique, different varieties

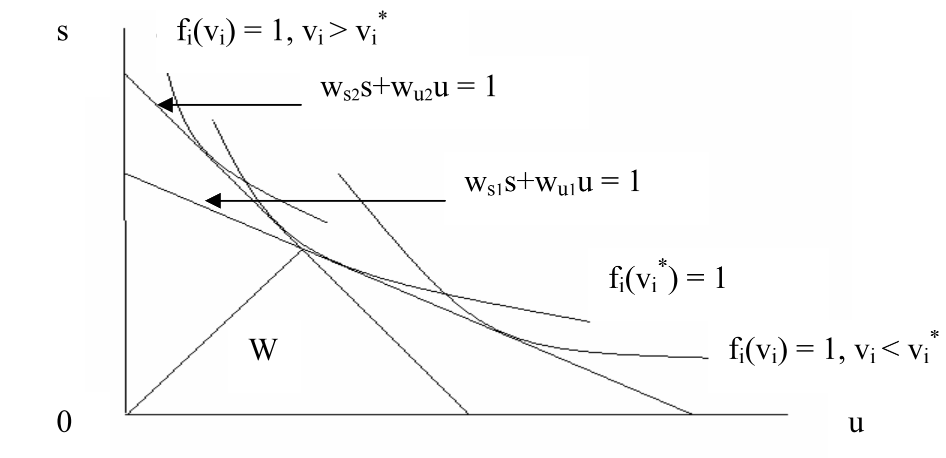


Figure 2: Choice of technique, different products

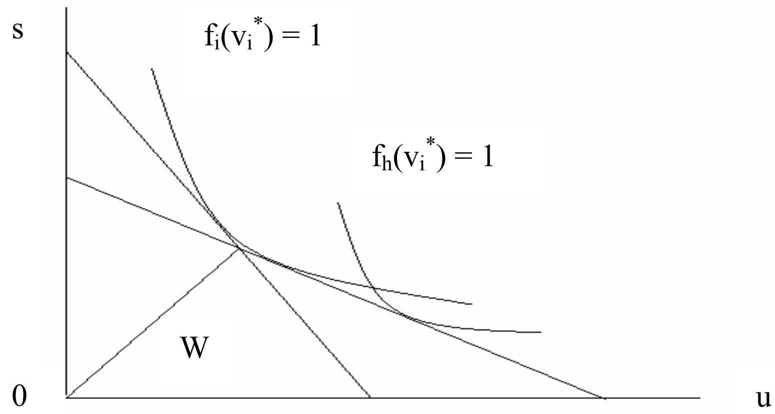
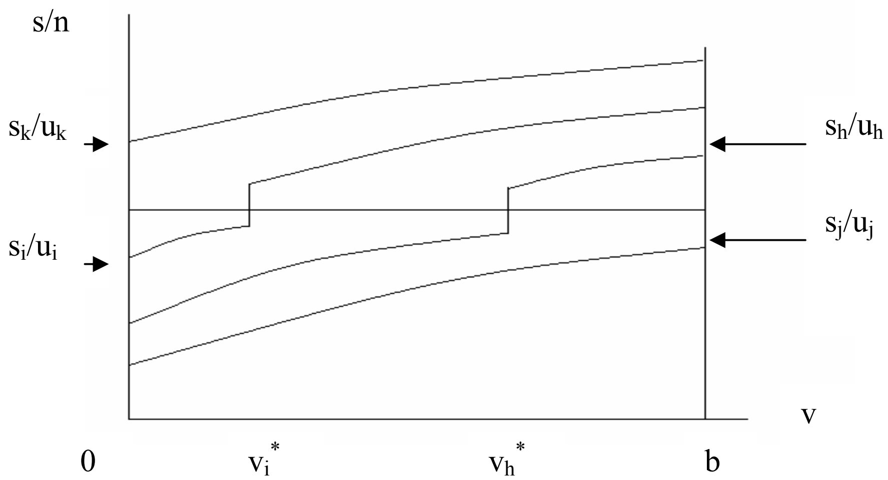


Figure 3: Choice of location, different varieties and products



Then Figure 2 shows that at point v_i^* in the quality spectrum, the good is produced only in the less skill-abundant country.

Both Figures 1 and 2 show the application of the *same* economic analysis to the determination of the location of different parts of the spectrum of products and varieties. The model is in fact a version of the Heckscher-Ohlin model with two factors and many goods as presented by Deardorff (1979).

The intersection of the two iso-cost lines in both Figures is at the *s/u* ratio given by

$$W = \frac{w_u^2 - w_u^1}{w_s^1 - w_s^2} \tag{13}$$

and all varieties produced in the skill-abundant country have s/u ratios in excess of W, while all varieties produced in the skill-scarce country have *s/u* ratios less than *W*.

For products *j* for which

$$\frac{s_j(b)}{u_j(b)} < W \tag{14}$$

the whole spectrum of production will be located in country 1, while for products *k* for which

$$\frac{s_k(0)}{u_k(0)} > W \tag{15}$$

all production will be located in country 2.

Thus we have the patterns of specialisation in products and varieties shown in Figure 3: products which have high skill-intensity across the quality spectrum (such as product *k*), so that all their varieties are produced in the skill-abundant country, products with low skill-intensity across the spectrum (product *j*), with all varieties produced in the skill-scarce country, and products such as *i* and *h* in which lower-quality varieties are produced in the skill-scarce country, but the switch-over point v* is lower for the more skill-intensive products.

Since the skill-intensity of all production processes in country 1 is less than W and in country 2 is greater than W, the factor-content version of the Heckscher-Ohlin theorem in the standard two-factor model continues to hold: all the exports of country 2 are more skill-intensive than its imports, so trade will embody a net outflow of the abundant factor.

In the case of products such as i and h, varieties of which are produced in both countries, unless the distributions of varieties are strongly unbalanced towards one side of the quality spectrum, we should expect country 2 to be a net exporter of product *i* and a net importer of product *h*.

In other words, the skill-abundant country will be a net exporter of goods whose skill-intensity, *averaged across the full product range*, is high.

So if we measure factor intensity at world level, we will observe countries being net exporters of products which are intensive in their abundant factors. However, the information on the skill-intensity of production is usually derived from a single country's statistics, so the measurement of skill-intensity may be affected by the fact that some varieties of some products are not produced in the country of measurement.

In conclusion this is a model which is firmly in the Heckscher-Ohlin tradition in which countries have common tastes and technology, and trade arises from differences in factor endowments of countries and factor requirements of goods. The model differs from the standard textbook HOS model in that factor endowment differences explain intra-sectoral rather than inter-sectoral specialisation: it is a Heckscher-Ohlin model of intra-industry trade.

3.3 The effects of the growth of North-South trade

Now consider trade in a two-country setting, in which the less skill-abundant country ('the South') grows. This could be interpreted as a stylised model of developments in the world economy in the 1980s; the rapid growth of South East Asian economies and China entering the world market.

The growth of international trade with the South will lead to the North moving up the quality spectrum in every sector, and will increase the demand for labour skills and push up the skill premium, without there necessarily being any inter-sectoral specialisation.

In Feenstra and Hanson's model, a flow of capital from North to South raises the skill-intensity of production and the skill premium in *both* countries. This property runs contrary to the prediction of the standard two-good two-factor HOS model, but is in line with some evidence on what has happened to wage differentials in low-wage trading economies (Robbins, 1994). Whether the skill premium rises in the South in the present model depends on the specification of the exogenous change that drives the growth of trade. If we assume a neutral expansion of aggregate output in the South relative to the North, caused by uniform expansion of the labour supply, technical progress or capital accumulation in the South, we should expect an increase in the relative demand for skilled labour both in the North and in the South. The Southern share of production of each good will rise. In Figure 1, the skilled/unskilled critical ratio at the value v^*, dividing the spectrum of production between country 1 (South) and country 2 (North), will increase. This implies that the production of some varieties will be transferred from the North to the South. These activities will be more skilled-labour intensive than those formerly produced in the South, but less skilled-labour intensive than those now produced in the North. Clearly this dynamic of international specialisation drives up the skill intensity of production in both countries.

When the North moves "up-market" in each product, the relative demand for skilled labour rises, but the relative supply is unchanged. To restore labour market equilibrium, production will have to shift from the more skill-intensive to the less skill- intensive varieties which the North continues to produce and from the more skill-intensive to the less skill-intensive sectors, and this will require an increase in the price of the most skill-intensive varieties, which in turn will require a rise in the relative wage of skilled labour. The skill premium goes up in the North. But the South moves up-market also, and the same argument implies a rising skill premium in the South also.

The case in which the shock is represented by a reduction of trade barriers is different. In this circumstance, a decline of transport costs, for example, will produce HO-type effects, with the relative demand for skilled labour rising in the North and falling in the South. The reason of this more conventional result is that the existence of transport costs causes the varieties in the 'middle' of each continuum to be produced in both countries and therefore non-traded. When transport costs decrease the non-traded overlapping band in the middle gets smaller and each country specialises in varieties at the respective extremes of the continuum[31].

However if we look at the North, in all cases the growth of international trade with the South will induce a rise in the skill premium in the North implying: a rise in the relative price of skill-intensive product varieties but uncertain effects on relative sectoral price indices (Lawrence and Slaughter observation 1), an increase in the relative employment of skilled workers in all sectors (observation 2), no systematic inter-sectoral shifts in

[31] I owe this point to Adrian Wood.

production (observation 3). In other words, this Heckscher-Ohlin model of intra-industry trade is consistent with *all* the phenomena which Lawrence and Slaughter use to cast doubt on the link between trade and the labour market. It is a model in which, clearly, trade will have factor market effects and we now turn attention to the issue of the likely size of these effects.

4. An empirical application to the Italian case

4.1 The level of aggregation

Empirical implementation of the analytical framework set out in the previous section is far from straightforward, because much less direct information is available about intra-sectoral trade than inter-sectoral trade.

The level of aggregation is an important reason why conventional estimates of the impact of trade on labour markets, whether based on factor content, factor price, or on CGE calculations, are generically likely to produce small numbers. The CGE computations in Smith (1998), for example, are done at the 3-digit level of the NACE industrial classification, a level of aggregation comparable to those used in most studies of this subject. But at this level, there is first of all fairly modest sectoral variation in factor market shares, and secondly a fair degree of intra-industry trade even in trade between the EU and non-advanced countries. With only limited difference in the sectoral distribution of imports and exports and only limited variation in the sectoral difference in factor shares, it is arithmetically inevitable that trade will have small labour market effects. In the same way, one might worry that Lawrence and Slaughter's failure to find the shifts in techniques of production towards less skill-intensity and in production patterns towards more skill-intensive products predicted by the Stolper-Samuelson theorem could reflect the fact that these shifts were present, but *within* sectors and not showing up at the level of aggregation of the data, as argued in detail above. Lawrence and Slaughter attempt to deal with this issue by showing the same phenomena at three levels of aggregation, of which the least aggregated is at four-digit SIC level. They suppose that disaggregation to this level will reveal the impact of vertical disintegration of production. However, even disaggregation to the four-digit level may fail to detect effects associated with quality and skill-content differences between similar products.

The empirical analysis here reported tries to deal with the issues of aggregation and vertical differentiation in evaluating the impact of trade on labour markets. We have chosen as the empirical case-study the Italy's trade with a group of countries we label 'less advanced countries' (LACs) which comprise all of the rest of the world except the EU, EFTA, the USA, Canada, Japan, Australia and New Zealand. (The LACs are not quite the same as non-OECD countries: they include Turkey and the countries which joined the OECD in the 1990s.) It is a wider category of countries than 'less developed countries' as usually defined, because of the inclusion of East European countries, all of Latin America and even the most advanced of the South East Asian countries. Trade with LACs makes up more than half of Italy's non-EU trade and thus more than 20% of all of Italy's trade. Furthermore, this is the part of Italy's foreign trade that might be expected to have the largest labour market impact.

The analysis focuses on manufacturing (NACE 260-495) and compares 3-digit and 8-digit data. There are 77 3-digit NACE sectors, with a total of 6635 8-digit CN products in the NACE-CN concordance provided with the COMEXT trade data[32]. The year for

[32] NACE is a classification of sectors, CN a classification of products, and it should be noted that no concordance, however detailed, can perfectly allocate the production of each individual product to a single production sector.

analysis is 1993. The first step of the empirical assessment of trade impact is to describe the trade flows.

4.2 The share of trade with/without labour market effects

In the previous chapter we discussed empirical work whose objective was to gain better understanding of the determinants of IIT by separating horizontal from vertical IIT. Here we are using the distinction between vertical and horizontal differentiation in intra-industry trade data to improve the measurement of the impact of trade on labour markets. The following example illustrates how trade impact may be misjudged because of a lack of information about vertical differentiation and sectoral composition.

Usually, the conventional factor content of trade calculations are carried out by using trade and industry data at 3 digits. Suppose that at this level of aggregation the share of IIT in total trade is 40%; conventionally, only 60% of total trade (inter-industry trade) has an impact on labour markets. But if 20% of total trade is vertical IIT (half of the overlap involves 2-way trade flows of different qualities), the share of total trade inducing effects on labour markets increases to 80%. This latter percentage would probably increase further if the IIT index was calculated at a greater level of disaggregation, given that the share of non overlapping trade usually increases with a narrower definition of the products traded.

As discussed in the previous chapter, at the 8-digit level it is possible to use unit values as a meaningful indicator of product quality. We can then discriminate between the two components of IIT by defining as vertical IIT those IIT flows in which the unit value of exports relative to the unit value of imports is outside a certain range of variation (±15%). Where the absolute value of the difference between the unit values for exports and imports is less than 15%, the IIT is counted as horizontal.

Following the methodology above reported, we have calculated IIT indices which distinguish vertical and horizontal components of Italy IIT. In addition, we have compared IIT indices calculated respectively at the 3 and 8-digit level in order to evaluate the impact of sectoral aggregation. In other words, this comparison allows us to single out the share of trade which is intra-industry trade at the 3-digit level but inter-product trade at the 8-digit level. Table 1 reports total IIT, vertical IIT (VIIT) and horizontal IIT (HIIT) for Italy-LAC trade in 1993.

Table 1 - Indices of intra-industry trade Italian trade with LACs. 1993					
IIT 3-digit	IIT 8-digit	VIIT 8-digit	$VIIT^+$	$VIIT^-$	HIIT 8-digit
43%	21%	16%	13%	3%	5%

Total value of exports involved : 27,357,340 (1000 ECU)
Total value of imports involved : 11,601,032 (1000 ECU)
Number of 3-digit sectors considered : 77
Number of 8-digit products considered : 6,635
Grubel-Lloyd indices are expressed as shares of total trade
LACs= Less advanced countries

Source: calculations on Comext data

As shown in table 1, the trade flows involved in the calculation of IIT indices indicate that Italy had a substantial trade surplus with the LACs in 1993. When in the next section I estimate the trade impact of Italy-LACs trade on Italian labour market, the results will be better interpreted with the effects of the trade surplus removed. This is done by considering the effect of a balanced trade change: where the factor content of exports is scaled down in proportion to the excess of exports over imports.

At the three digit level, the Grubel-Lloyd index of intra-industry trade is 43%. Thus almost half of trade is excluded from a conventional 3-digit factor-content calculation because 43% of trade consists of offsetting flows of imports and exports within 3-digit sectors, that is to say flows which have zero effect in the factor content calculation.

Compare the statistics calculated at the 8-digit CN level. Now the Grubel-Lloyd index is 21%, so half of the trade excluded from the 3-digit analysis as intra-industry trade is inter-product trade at the 8-digit level. Different 8-digit products within a 3-digit sector can have quite different factor requirements.

The difference between the two classifications is illustrated by the fact that there are almost 100 times more 8-digit commodities than 3-digit sectors. It can also be illustrated by example: CN code 84182199 refers to 'Household refrigerators, compression-type, capacity between 250 and 340 litres, excluding table models and building-in types' and this is one of 68 commodities which correspond to NACE sector 346 'domestic electrical appliances'.

Of the 21% of Italy-LAC trade that is IIT at the 8-digit level, only 5% is HIIT, while 16% is VIIT. One can further distinguish between 'VIIT+' trade, where the unit values of the export flow are greater (by at least 15%) than the import unit value; while 'VIIT-' trade describes the case where it is the import unit values that are larger. In the case of Italy, 13% is VIIT+, and 3% is VIIT-. So the division between the two categories of VIIT reflects the fact that Italy is more advanced than virtually all the LACs.

Figure 4: Italy-LAC trade 1993

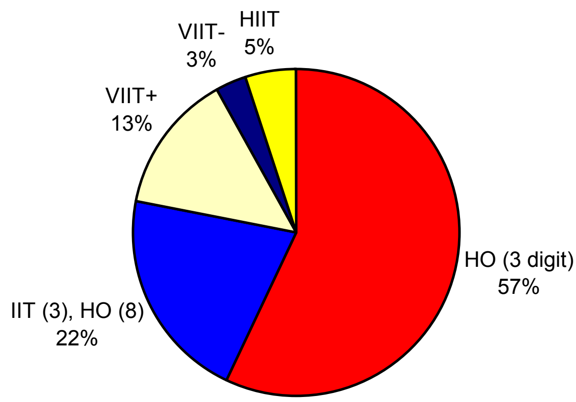


Figure 4 illustrates these distinctions graphically. 'HO (3-digit)' refers to trade that is inter-industry at the 3-digit level, 'IIT (3), HO (8)' is the part of trade that appears to be intra-industry at the 3-digit level but inter-product at the 8-digit level, while the different forms of intra-industry trade at the 8-digit level are labelled in accordance with the terminology used above.

Thus whereas 43% of trade is counted at the 3-digit level as intra-industry trade which has no factor market impact, disaggregation to the 8-digit level suggests that only 5% of trade is actually intra-industry trade in products of the same type and comparable quality. The remaining 38% consists of matching flows of imports and exports, but the matching is either of different products in the same sector (22%) or of different qualities of the same product (16%). These two kinds of matched trade are what Wood refers to as 'non-competing imports'; and both have the potential to have significant labour market effects.

In other words, if the FCT calculation in the case of Italy-LAC trade was performed at the conventional 3-digit level, the underestimation of trade impact due to the high level of aggregation would involve 22% of total trade, while the percentage of underestimation associated with the absence of information about vertical product differentiation would be 16%. Thus, the total distortion would involve a percentage of 38%, a quite substantial fraction of total trade.

4.3 Trade impact on labour markets

The analysis of IIT indices reported in the previous section suggests that in the case of Italy product heterogeneity matters, and that any calculation of the factor content of trade should take this aspect into account. In particular, we expect that an eventual comparison between FCT results at the 3-digit an the 8-digit level would signal substantial differences in trade impact, in line with the evidence above reported. However the task of implementing this comparison is not a simple one. While a conventional estimate of the effects of trade with the LACs on the Italian labour market may be easily undertaken at the 3-digit NACE level at which both trade data (from the European Commission's COMEXT database) and industrial data (from the EC's INDE database) are available, an estimate at the 8 digit level is very difficult to perform because of the absence of industrial or labour market data at this level of disaggregation.

This chapter attempts to make a start on that task, but it needs to be emphasised that the calculations presented here are of a tentative nature. Confidence in the robustness of the numbers presented here would require the exercise to be repeated on data for other countries and would also be helped by a less crude treatment of the skill composition of the labour force.

The first step is to follow Greenaway and Torstensson (1996) in seeking evidence that unit value comparisons do indeed provide evidence that is consistent with the kind of model presented. Landesmann and Burgstaller (1997) have computed unit value comparisons for a number of 3-digit NACE sectors for trade between the EU and a number of countries, EU and non-EU. Unit value differences between a country's exports to the EU and all countries' exports to the EU are computed at the 8-digit level and then averaged to the 3-digit level. Cross-country regressions of income and educational data against these 'price gaps' reveal significant relationships which are consistent with the model of section 3: differences in countries' relative endowments of human capital (measured by the percentage of the adult population who have completed high school education) and of development in general (measured by GDP per worker) give rise to specialisation in different parts of the quality spectrum.

The key requirement, however, is to find some indicator at product level of skill-intensity. The model implies that within an 8-digit product category there will be a systematic relationship between the prices of product varieties and their skill intensity, and given the tight definition of an 8-digit product, we can have a degree of confidence that the main source of unit value differences is likely to be in the characteristics of the product (rather than, say, in how much raw material or intermediate product is incorporated in it).

There is no such reason to suppose that there will be a systematic relationship between unit values and the skill-intensity of production across 8-digit products or, *a fortiori*, across 3-digit sectors. A relationship between unit values and skill-intensity at the 3-digit level should therefore reflect the underlying relationship within the 8-digit categories, overlaid by a great deal of noise. But given that data on skill-intensity is available only at the 3-digit level, this is where we have to look for empirical evidence.

On the input side, the most readily available data on skill inputs is 1993 INDE data for Italian inputs of manual and non-manual labour in 3-digit sectors, and input coefficients were defined as ratios of non-manual labour to turnover (UNY) and manual labour to turnover (SKY). Regression of the average unit-value of Italian 1993 exports to LACs (UVX) (calculated at 8-digit level and averaged for each sector across all 8-digit commodities) against these input coefficients across 77 3-digit sectors gave:

$$\underset{(11.20)}{SKY = 1.3287} + \underset{(7.19)}{0.31762} \ln (UVX) \qquad R^2=0.41$$

$$\underset{(13.56)}{UNY = 4.7556} + \underset{(2.65)}{0.34618} \ln (UVX) \qquad R^2=0.09 \qquad (16)$$

(t-statistics in parentheses).

At first sight the positive coefficient in the second regression may seem surprising, but it is easily checked that the two regressions together imply that the ratio of non-manual to manual labour is increasing in the unit value of exports, which is consistent with the notion of product quality being skill-intensive. It is also acceptable that higher quality products require more of both kinds of labour.

We now take the large step of applying the equations (16) to the data on the unit values of Italian exports and imports of individual 8-digit products to predict input requirements of individual products. We then use the derived coefficients to conduct a factor content calculation on the full 95% of Italian-LAC trade that is not horizontal intra-industry trade. The slope coefficients in the regressions are used to adjust the input coefficients for individual products relative to the sector average, so that within each 3-digit sector, the sectoral input coefficients remain at the levels given in the INDE data and used in the 3-digit factor content calculation.

Table 2 shows practically how the FCT calculation at the 3-digit and the 8-digit level is implemented just looking at a single sector (NACE 365) to illustrate the method of estimation here applied. In the first column all 8-digit products included in the NACE 365 (Manufacture of transport equipment not elsewhere specified)[33] are shown. The 3-digit factor content calculation takes the ratios of manual and non-manual labour to the value of production in the industrial data and assumes that these ratios will apply to the production of exports and import substitutes[34]. SKY and UNY coefficients at the 8-digit level in columns 8 and 9 are obtained by applying equations (16) to unit values of exports (UVX) at the 8-digit level in column 7. The estimation of labour co-efficients actually amounts to adjusting the observed value of the group by β ($\ln UVX_8$ - $\ln UVX_g$) for each 8 digit good, where β is the slope coefficient coming from (16), UVX_8 is the UVX of the 8 digit good and UVX_g the group value (the unit value averaged across all 8-digit commodities included in the group, where the weights are export values-these were the statistics used for each sector in the estimation of (16)). For example, in the case of the 8-digit code 87131000 belonging to NACE 365, input coefficients are obtained through the following calculation:

$SKY_{(87131000)} = 1.16 + 0.318\ (\ln 10.96\ - \ln 6.69)\ = 1.32$

$UNY_{(87131000)} = 6.55 + 0.346\ (\ln 10.96 + \ln 6.69)\ = 6.72$,

where:

$1.16 = SKY_{(365)}$, observed SKY for sector 365
$0.318 = \beta$ derived from (16) for SKY
$10.96 = UVX_{(87131000)}$, unit value of 8 digit good 87131000
$6.69 = UVX_{(365)}$, unit value averaged across all 8-digit goods included in 365
$6.55 = UNY_{(365)}$, observed UNY for sector 365
$0.346 = \beta$ derived from (16) for UNY

[33] CN code 87131000 refers to "Invalid carriages, not mechanically propelled", CN code 87139000 refers to "Invalid carriages, motorized or otherwise mechanically propelled (exl. mechanically designed motor vehicles and bicycles), CN code 87150010 refers to "Baby carriages", and so on.

[34] Input coefficients at the 3 digit level reported in column 8 and 9 (first row) are the actual ones derived from INDE data set.

Table 2 Example of FCT calculation at the 3-digit and 8-digit level - NACE 365

(1) Code	(2) M val	(3) M vol	(4) X val	(5) X vol	(6) UVM	(7) UVX	(8) sky X	(9) uny X	(10) sk cont X	(11) un cont X	(12) sk con M	(13) un con M
365	3849		9144				1.16	6.55	10.59	59.85	4.46	25.19
87131000	495	33	252	23	15	10.96	1.32	6.72	0.33	1.69	0.65	3.32
87139000	270	31	439	30	8.7097	14.63	1.41	6.82	0.62	2.99	0.38	1.84
87150010	436	120	6315	852	3.6333	7.41	1.19	6.58	7.52	41.56	0.52	2.87
87150090	2068	676	304	40	3.0592	7.60	1.20	6.59	0.36	2.00	2.48	13.63
87168000	580	269	1834	1188	2.1561	1.54	0.69	6.04	1.27	11.07	0.40	3.50
Tot 8 digit									10.106	59.320	4.432	25.164

FCT at the 3-digit level in NACE 365

SK = 10.59 - 4.46 = 6.133
UN = 59.85 - 25.19 = 34.657
SK/UN = 0.177

FCT at the 8-digit level in NACE 365

SK = 10.106 - 4.432 = 5.674
UN = 59.320 - 25.164 = 34.156
SK/UN = 0.167

Then the FCT at the 3-digit and the 8-digit level is calculated by multiplying input coefficients and the value of trade flows together (products reported in columns 10-13). Table 2 shows that the FCT calculated at the 3-digit level is different from the FCT at the 8-digit: the skilled/unskilled ratio is 0.177 against 0.167. In the example reported in table 2, the conventional procedure based on domestic input coefficients (those derived from UVX) has been pursued in order to estimate the FCT. But a variant on the calculation in the spirit of Wood (1995) could be also undertaken: using the unit values of *imports* (UVM) and the regression coefficients above to impute input coefficients to import-competing production in the factor content calculation.

Following the procedure above exemplified, the FCT calculation has been undertaken at the 3-digit level with reference to 77 sectors and at the 8-digit level with reference to 6635 products included in those sectors. At the 3 digit level, the conventional FCT calculation estimates the labour market impact of the 57% of Italian trade with LAC that is measured as inter-industry trade (see figure 4). At the 8 digit level, a first calculation attempts to calculate the labour market effects of the 22% of Italy-LAC trade that is measured as intra-industry trade at the 3-digit level but as HO-type trade at the 8-digit level (as shown in figure 4) by imputing labour input coefficients to each 8-digit commodity, but with the same input coefficients for exports and import substitutes. In this first calculation using same input coefficients, the impact of the 2-way trade at the 8-digit level, *intra-product trade*, is zero but the labour market effects of *inter-product trade* are different from zero for the reason that input coefficients differ across products. In other words, this method of calculation allows us to capture the impact of HO-type trade at the 8-digit level. The second calculation goes further: by imputing separate coefficients to exports and import substitutes, it allows us to capture additional factor market effects from intra-product trade, that is vertical intra-industry trade at the 8-digit level (16% of Italy-LAC trade)

Table 3 reports trade impact results.

Table 3 - The impact of Italy-LAC trade on the Italian labour market. 1993

	Sk/un ratio in exports	Sk/un ratio in imports	Trade impact on skilled	Trade impact on uskilled	B. trade impact on skilled	B. trade impact on uskilled	B. trade impact on relative lab. demand
3 digit results	0.427	0.345	6.51%	5.02%	0.76%	-0.06%	**0.82%**
HO 8-digit results	0.418	0.306	6.74%	5.12%	1.20%	0.12%	**1.08%**
8 digit results with VIIT	0.418	0.299	6.83%	5.16%	1.29%	0.16%	**1.13%**

Source: calculation on Comext and Inde databases

The first two columns show factor content of trade in terms of skilled/unskilled ratio. Italian exports are more skill-intensive compared with imports from the LAC area. In addition, moving from the 3-digit to the 8-digit level, the gap between exports and imports in the skilled/unskilled ratio becomes larger: 37% increase (the inclusion of VIIT in the 8-digit calculation raises the gap only marginally: 6% more) . This suggests that trade impact is more pronounced if the calculation is carried out at a more disaggregated level. Columns three and four display the impact of trade in terms of labour demand for skilled and unskilled: FCT calculations at the three digit level show that in one year trade with LACs raises the demand for manual labour in Italian manufacturing by 5.02% and for non-manual labour by 6.51%[35]; FCT calculations at the 8-digit level reveal that the impact is slightly bigger for both type of labour: +5.12% for manual workers and +6.74% for non-manual workers (+5.16% and +6.83% in the case of the 8-digit results with VIIT). Both numbers are positive, because Italy has a trade surplus with LACs, and both numbers are non-trivial, reflecting the quantitative significance of trade with LACs.

However, as already discussed, the results are better interpreted with the effects of the trade surplus removed. This is done by considering the effect of balanced trade change: where the factor content of exports is scaled down in proportion to the excess of exports over imports. This sort of computation is reported in columns five and six of table 3. In the 3-digit factor content calculation, balanced Italian-LAC trade implies a 0.76% increase in the demand for non-manual labour in Italy and a 0.06% reduction in the demand for manual labour. These numbers are smaller than the 6.51% and 5.02% derived from the unbalanced trade calculation, but it is the difference between the two numbers which is most meaningful: balanced trade with LACs raises the relative demand for non-manual labour in Italy by 0.82%.

The 8-digit factor content calculation using only export unit values gives a 1.20% increase in demand for non-manual labour and a 0.12% increase in demand for manual labour, so the change in the relative demand for non-manual labour rises to 1.08%. The 8-digit calculation allowing for vertical intra-industry trade implies respective changes of 1.29% and 0.16%, so a change in the relative demand for non-manual labour of 1.13%[36].

The analytical framework here offered provides an alternative approach to that of Wood for the calculation of the impact of what he calls ‘non-competing imports’, effectively intra-industry trade, on the labour market effects of trade. From FCT results above reported three conclusions can be drawn. (1) The more disaggregated calculations

[35]Percentages respectively of total manual and total non manual employment.
[36] Note that in the 8-digit calculation, the balanced trade impact raise demand for both factors. This result is not strange if we assume the existence of other production factors like physical capital

produce significantly larger labour market effects of trade. (2) The scale of the difference is less than in Wood's calculations: here intra-industry trade has an additional impact of less than 40% (raising the relative demand effect from 0.82% to 1.08% or 1.13%). (3) Most of the labour market effect of intra-industry trade comes from allowing for inter-product specialisation within sectors rather than for intra-product trade.

4.4 Sensitivity analysis of results

The FCT estimates at the 8-digit level presented in the previous section are based on an inference from two statistical relationships whose robustness needs further exploration. The first step is to ask how sensitive are results to the changes of the estimated values of the intercept and slope coefficient in equation (16). Table 4 shows the range of variation of FCT estimates at the extreme values of the 95% confidence interval for the slope coefficient.

Table 4 - The 8-digit impact of Italy-LAC trade on the Italian labour market. 1993
Sensitivity of results to the change of the slope coefficients in equations (16)

Slope coefficients*		Increase of b. trade impact on rel. demand for skilled moving from the 3-digit to the 8-digit calculation	
Sky equation	*Uny equation*	*HO method*	*VIIT method*
0.31762 (original)	0.34618 (original)	**0.26%**	**0.31%**
0.4059 (high)	0.6072 (high)	**0.24%**	**0.29%**
0.2292 (low)	0.6072 (high)	**0.00%**	**0.00%**
0.2292 (low)	0.08508 (low)	**0.27%**	**0.33%**
0.4059 (high)	0.08508 (low)	**0.52%**	**0.62%**

(*) The terms "high" and "low" refer to the values at the extremes of the 95% confidence interval for the slope coefficents in equations (16)

When the FCT calculation at the 8-digit level is undertaken by assuming for both SKY and UNY equations the highest (or the lowest) value of the 95% confidence interval for the slope coefficient, results turn out to be close to those obtained with the original estimated coefficient (in table 4 compare the second row and the fourth row with the first one. Results at the 8-digit level are reported in terms of the difference from results at the 3-digit level).

When trade impact is evaluated by assuming for the SKY equation the smallest value and for UNY equation the highest value of the confidence interval, labour market effects decline and turn out to be similar to the impact gained at the 3-digit level (change of

0.82% in relative demand for skilled labour; so the difference is zero). On the contrary, when the highest value of the interval is inserted in the SKY equation and the lowest value in the UNY equation, the trade impact is bigger (+0.52% or +0.62% in comparison with the calculation at the 3-digit level).

In the end, confidence interval-based analysis of the results gives us an outcome consistent with what we expect when coefficients in equations (16) are manipulated. In particular, at the extremes of the 95% confidence interval for the slope coefficients, the range of 8-digit FCT results is from 0.82% to 1.44% for the change in relative demand for skilled labour in terms of total effects (including the 3-digit inter-industry effects) or, in other words, from 0% to +0.62% in terms of the difference from results gained at the 3-digit level (which are 0.82%).

I have also tested the robustness of results by using unit values of imports (UVM) instead of UVX in equations (16). The estimated inter-sectoral relationship between input coefficients and UVMs is given by equations (17):

$$\begin{aligned} SKY &= \underset{(12.25)}{1.3777} + \underset{(7.33)}{0.32355} \ln(UVM) \qquad R^2=0.42 \\ UNY &= \underset{(14.52)}{4.9513} + \underset{(2.02)}{0.27024} \ln(UVM) \qquad R^2=0.05 \end{aligned} \tag{17}$$

(t-statistics in parentheses).

Equations (17) display numbers very similar to those produced by equations (16). However, the difference between the slope coefficients for SKY and UNY is slightly bigger in equations (17) and this predicts a significantly bigger impact of trade on labour markets.

Table 5 reports the 8-digit FCT calculation when the slope coefficients of equations (17) are used to estimate input requirements at the product level. As expected, the numbers in table 5 are very close to the original estimates reported in table 3. However, the balanced trade impact on relative demand for skilled labour is slightly bigger in the case of estimates based on equations (17): 1.12% against 1.08% in HO 8-digit calculations, and 1.19% against 1.13% in 8-digit calculation with VIIT. This result is quite comforting in terms of confidence in the use of UVs.

Table 5 - The impact of Italy-LAC trade on the Italian labour market. 1993. 8-digit estimates based on equations (17)

	Sk/un ratio in exports	Sk/un ratio in imports	Trade impact on skilled	Trade impact on uskilled	B. trade impact on skilled	B. trade impact on uskilled	B. trade impact on relative lab. demand
3 digit results	0.427	0.345	6.51%	5.02%	0.76%	-0.06%	**0.82%**
HO 8-digit results	0.417	0.300	6.75%	5.10%	1.21%	0.08%	**1.12%** (1.08%)*
8 digit results with VIIT	0.417	0.293	6.84%	5.13%	1.30%	0.11%	**1.19%** (1.13%)*

(*) Original estimates based on equations (16) are reported in brackets
Source: calculation on Comext and Inde databases

Another experiment in sensitivity testing estimates equations (16) in the reverse direction by assuming that UVX are explained by SKY and UNY. Unfortunately the slope coefficients produced by reverse regressions give results which are very different from the original estimates and they turn out to be perverse because the relative demand for skilled labour decreases. This result casts doubt on robustness of my estimates[37].

This unsatisfactory result induced me to consider another way to conduct a sensitivity analysis based on reverse regressions. A possible alternative could be to look at input requirements in terms of a single variable: skilled/unskilled ratio (SKUN). The advantage of this solution is that regressions involve only two variables. In this case, in fact, it would be possible to estimate SKUN by using UVX and to carry out the reverse regression in which SKUN explains UVX; then, sensitivity analysis would follow by comparing results deriving from the two alternative estimates. But in the FCT calculation the sectoral requirements of each input (SKY and UNY in this context) cannot be replaced by sectoral factor ratios (SKUN in this context).

The final measurement of trade impact, the percentage change in relative demand for skilled, is equivalent to the percentage change in the skilled/unskilled ratio of the economy. In fact if :

$$\sum a_s{}^i (X_i - M_i) = \text{ the impact of trade on skilled labour}$$

$$\sum a_u{}^i (X_i - M_i) = \text{ the impact of trade on unskilled labour}$$

(where $a_s{}^i$ = SKY, $a_u{}^i$ = UNY)
the percentage change in skilled/unskilled ratio of the economy is:

$$\frac{\left(\Delta SK/UN\right)}{SK/UN} = \frac{\sum a_s{}^i (X_i - M_i)}{SK} - \frac{\sum a_u{}^i (X_i - M_i)}{UN}$$

(where SK = skilled employment in the economy, UN = unskilled employment in the economy).

From the relationships reported above it is evident that, if we replace the sectoral input coefficients with the sectoral skilled/unskilled ratios, it would be not possible to link

[37] Reverse regressions produce the following equations in order to estimate input coefficients at the product level: SKY=0.446484+0.778634Ln (UVX) and UNY= -2.31062+4.038772 Ln (UVX).
By using these numbers in the 8-digit calculation with VIIT, the impact of trade in terms of percentage change in relative demand for skilled is -0.43%, while in the HO 8-digit calculation the change of relative demand for skilled is –0.22%.

arithmetically the impact of trade with the change in the skilled/unskilled ratio of the economy. In other words, with only sectoral skilled/unskilled ratios, we would not have enough information to establish in what proportion trade flows change the skilled/unskilled ratio of the economy. For this reason it is not possible to carry out sensitivity analysis on FCT calculation based on skilled/unskilled ratios.

4.5 Interpretation of numerical results

The second step of the analysis of results is to verify the compatibility between the evidence presented in section 4.2 and the FCT results obtained in section 4.3. In other words, we have to check if the results derived from the FCT calculation are consistent with the numbers presented in the analysis of the IIT indices from which the share of trade with and without labour market effects has been extrapolated.

Table 6 compares the shares of Italy-LAC trade with/without labour market effects, the balanced trade impact on relative demand for skilled labour and the variability of unit values. When we add inter-product trade to inter-sectoral trade at the 3-digit level (HO-3), the share of trade with labour market effects moves from 57% to 79%. Therefore we might expect a proportional increase in the balanced trade impact on the relative demand for skilled labour by moving from the 3-digit to the 8-digit FCT calculation. As shown in table 6, the rise of the impact is slightly less than proportional (an increase of 32% against 39%).

The VIIT line shows the impact of measuring the labour market impact of the 8% of trade which is VIIT. Here we have to be a little careful in considering the effects. In the HO-8 calculation, the factor content of intra-product trade was done using export unit values to calculate the input coefficients of both imports and exports, so a balanced VIIT flow within an 8-digit product would have zero impact. In the VIIT calculation, we use the import unit values to estimate the input coefficients for imports, leaving the export calculation unchanged. Thus only one side of VIIT is being treated differently in this calculation, so even though the VIIT share is 16%, it would be more appropriate to think of the trade share relevant to this calculation as being 8%, on the assumption that VIIT is close to being balanced if overall trade is balanced.

Table 6 also provides information about the variability of the unit values on the basis of which input coefficients are estimated. The fact that UVs have a slightly higher standard deviation at 3-digit level than at 8-digit level implies that there will be a little less variation in the estimated input coefficients at the 8-digit level than there is in the measured 3-digit input coefficients. For the VIIT calculation, table 6 provides the appropriate measure of how far, on average, are the (logs) of import and export unit values.

Table 6 - Comparison between share of trade with/without labour market effects, trade impact and variability of unit values

Share of trade	B. trade impact on rel. demand for skilled	Ratio between impact and share	Variability of UVs
HO (3) = 57%	0.82%	1.44	1.82 (1)
HO (8) = 79%	1.08%	1.37	1.70 (2)
VIIT = 16%	0.050%	0.31	0.47 (3)

(1) = weighted standard deviation of 3-digit Ln (UVX)
(2) = weighted standard deviation of 8-digit Ln (UVX)
(3) = weighted average difference between Ln (UVX) and Ln (UVM) at 8-digit level

Interpretation of Table 6 is facilitated by recalling that a factor content calculation is a calculation of covariance between net trade flows and factor intensities. Denote net exports of product *i* in sector *j* by

$$n_{ij} = X_{ij} - M_{ij} \tag{18}$$

and net exports of sector *j* by

$$n_j = X_j - M_j \tag{19}$$

where

$$n_j = \sum_i n_{ij} \tag{20}$$

Suppose there is balanced trade so

$$\sum_j n_j = 0 \tag{21}$$

A sectoral calculation of the factor content of trade is

$$FCT(3) = \sum_j a_j n_j = \sum_j (a_j - a) n_j \tag{22}$$

where the a_j are the input coefficients of the relevant factor and *a* their cross-sectoral average. This shows the factor-content calculation as a covariance.

A disaggregated factor content calculation is

$$\begin{aligned} FCT(8) &= \sum_{ij} a_{ij} n_{ij} = \sum_j (\sum_i (a_{ij} - a_j) n_{ij} + a_j n_j) \\ &\approx \sum_j (\sum_i (a_{ij} - a_j)(n_{ij} - n_j) + a_j n_j) \\ &= \sum_j (\sum_i (a_{ij} - a_j)(n_{ij} - n_j)) + FCT(3) \end{aligned} \tag{23}$$

where the approximate equality reflects the fact that the sectoral input coefficient is not the simple arithmetic average of the product input coefficients within the sector. This equation shows that the addition to the FCT measure from disaggregation is approximately the sum across sectors of the intra-sectoral correlation of trade flows and input coefficients, another covariance.

Formally, the covariance between two variables is related to the standard deviation of each variable and the correlation coefficient indicating the strength of the association between them.

$$Cov(x, y) = \sigma_x \sigma_y \rho_{xy} \, ,$$

Here we are measuring the standard deviation of the relevant trade flows by the complements of the IIT indices. 1-IIT(3) measures the variability of the net trade flows which are included in the FCT(3) calculation as having labour market effects. It is not formally a standard deviation (because it is the sum of absolute differences rather than the square root of the sum of squared differences), so the above relationship is illustrative rather than precise. In the FCT(8) calculation, there is more variability in the trade statistics and still more in the VIIT calculation. These are the numbers 57%, 79% and 95% referred to above.

But now we see that there are two reasons why the estimated impact of trade might not rise in strict proportion to the volume of trade included in the calculation. We need first to consider the variability in the factor input coefficients. The variance in the input coefficients depends on the variance on the unit values used in their estimation, and in fact the variability of unit values is slightly lower at the product level than at sectoral level, specifically, the weighted standard deviation of Ln (UVX) is smaller at the 8-digit than at the 3-digit level (1.70 against 1.82). The Heckscher-Ohlin effects are a little less than proportionate in the 8-digit calculation because the lower variablility of unit values leads to the inference of a slightly lower variation in skill-intensity among 8-digit products than between 3-digit sectors.

There is a third potential difference – the underlying correlation between the variables might well differ at different levels of disaggregation – there might as a simple matter of fact be less scope for Heckscher-Ohlin specialisation among 8-digit products or among varieties within 8-digit products than there is among 3-digit sectors.

Table 7 - Predicted trade flows

Share of trade	Prediction 1	Coefficient variation	Trade share *coeff. var.	Prediction 2	Actual	Implied rel. correlation
57	82.0	1.82	103.7	82.0	82	1.00
79	113.6	1.70	134.3	106.2	108	1.02
8	11.5	0.47	3.80	3.0	5	1.68

Table 7 elaborates on Table 6. The “trade shares” column for each of the three categories of trade is adjusted in the case of VIIT to show 8% rather than 16%. “Prediction 1” shows what the labour market impacts would be if they were strictly proportionate to trade shares. “Prediction 2” shows the impacts that would be predicted on the basis of the product of the trade share and the variability of the unit values. In terms of the covariance formula, it amounts to assuming the underlying correlation coefficients are unchanged. The ratio between the “actual” results of the factor content calculation in the final column and “prediction 2” tells us the implied correlation, shown relative to HO-3 trade.

The extension of the calculation to the 8-digit level is seen to involve only a small change in the variability of input coefficients compared with the 3-digit level, and the implied correlation in the data between input coefficients and trade flows is remarkably close. The VIIT trade has (perhaps inevitably) smaller variation in input coefficients, but one that has an apparently significantly stronger relation in the data with trade flows. At the very least, this analysis demonstrates that Heckscher-Ohlin effects are not weaker in more disaggregated analysis.

4.6 A comparison with existing work

How to locate the analysis developed in this chapter in relation to the debate on trade and jobs? In section 2 of the present chapter I have offered an overview of the copious literature on trade and labour markets. We have observed an apparent methodological dichotomy between analyses aiming to estimate the trade-driven shift in labour demand via FCT calculation and the studies focussing on the link between relative wages and prices of traded goods. Trade theorists especially have denied the existence of a strong link between trade and income distribution because empirical evidence does not support entirely the predictions of HOS model, which is assumed as the standard framework to deal with the issue. This position of trade theorists is justified mainly by the weak link emerging in the empirical analysis between factor prices and good prices, and by the pervasive non-neoclassical relationship between factor ratios and relative remunerations. Even if FCT calculations provide evidence of a more robust impact of trade on labour markets (via labour demand), the majority of trade theorists do not assign great importance to this result because they consider FCT analysis theoretically ill-founded[38]. However, the dichotomy between the two approaches (FCT versus "prices-wages" analysis) has been emphasized excessively. As Smith (1999) has observed, the relation between the two types of method can be clarified in a context of CGE analysis: "…An advantage of the CGE approach is that it can bridge these methodological gaps by using the same model to produce results on the impact of trade both on labour demand, with factor prices unchanged, and on factor prices, when factor markets are allowed to clear.."[39].

So, it seems to me that the main issue is not to establish if a price-oriented approach is superior to a demand-oriented one. As observed by Alasdair Smith, whatever the methodology adopted, the point is that the standard inter-sectoral analysis fails to produce relevant labour market effects because is not able to provide an adequate treatment of factor proportion and of intra-industry trade as trade in products that are identical in their factor proportion. The work presented in this chapter starts from identifying the inadequacy associated with the standard inter-sectoral approach and provides a FCT analysis modified to capture labour market effects acting within sectors in terms of factor substitution induced by inter-product trade and vertical intra-product trade. In other words, my analysis is a FCT calculation able to capture in intra-industry trade the labour market effects of that component of trade which Wood includes in the term "non-competing imports". In the literature surveyed in section 2 of this chapter, many contributions examined (Wood, Freeman, Krugman, Smith) assumed (implicitly or explicitly) that the factor content of trade underestimates the impact of trade on labour demand (because it does not take account of defensive innovation and additional general equilibrium effects). So, also in the present context, my estimate has to be considered as a downward measure of the labour market effects of trade. This implies that the choice of FCT methodology for the evaluation of labour market effects of trade turns out to be strategically correct because, whatever the magnitude of trade effect is, one can affirm that the impact of trade on labour markets is "no less than" the value deriving from FCT calculations.

5. Conclusions

I have presented a model here in which intra-industry trade is explained on Heckscher-Ohlin lines by factor endowment differences between countries and factor intensity differences between products. The properties of the model are more consistent with stylised facts about North-South trade than the traditional Heckscher-Ohlin model of inter-industry trade.

Applying the model to trade between Italy and a broad definition of 'less advanced countries' and inferring the factor content of intra-industry trade from the inter-sectoral relationship between factor intensity and average unit values of exports, I find that allowing for trade that is intra-industry but inter-product adds significantly to the estimated factor market impact of trade, while the additional impact of intra-product trade is small.

[38] In spite of the demonstration of Deardorff and Staiger (1988) that the FCT can be used to indicate effects of trade on relative factor prices.
[39] Smith (1999), pag.96.

The overall additional effect of intra-industry trade is smaller than that which Adrian Wood ascribes to 'non-competing imports'.

The empirical estimates are based on an inference from two statistical relationships and the robustness of the empirical work needs further exploration in terms of extension to other countries and years. Nevertheless, once the basic idea is accepted of a relationship between unit values and skill intensity, the calculations produce estimates of the labour market impact of intra-industry trade that are consistent with data on the variability of unit values at the 8-digit level.

However, future research has to explore the important issue concerning the characterisation of labour skills. In my work, as in other work on European data, I divide labour between non-manual and manual, a different distinction from that between production and non-production workers commonly used in American work on this issue. But it is arguable that neither distinction does a good job of capturing the distribution of skills in the labour force. Figure 7 in Lawrence and Slaughter (1993) has a glaring but unremarked feature that should cast strong doubt on whether their data can be interpreted within a Heckscher-Ohlin approach. At the four digit level, they show sectoral changes in the relative wages of production to non-production workers that vary between -55% and 130%; while the ranges are -8% to +18% at the two-digit level and -50% to +45% at the three-digit level. All of these numbers are wildly inconsistent with a model in which there are two kinds of intersectorally mobile labour, and in which the same relative wage should be observed in each sector. Sectoral 'skill ratios' apparently fail to capture much quality differentiation at product level, and so may be largely irrelevant to the actual skill composition of trade.

The present work has offered an alternative analytical framework to the traditional HOS model of inter-sectoral trade assumed by Lawrence and Slaughter. The empirical application of this framework to the Italian case has shown that factor substitution could operate *within* sectors as well as between sectors. However, as we have emphasised, the methodology presented in this work to evaluate the impact of intra-industry trade on labour markets needs to be supported by further empirical investigation and a less crude approach to the modelling of the skill content of production would also be desirable.

Appendix

The sources of industry and trade data are the same of those used in the second chapter (INDE and COMEXT databases) with the difference that, in the third chapter, all data refer to Italy in 1993. The group of “less advanced countries” (LACs) was taken as the rest of non-EU world, less the USA, Canada, Japan, Australia, New Zealand, and the EFTA countries. The 3-digit NACE sectors considered in the analysis are 77 and are reported in table 1A. Table 2A reports labour market and trade data for these sectors.

Table 1A - 3-digit NACE sectors included in the sample

NACE code	Description
2600	Chemical and man-made fibres (25+26)
3110	Foundries
3120	Forging; drop forging, closed dieforging, pressing and stamping
3130	Secondary transformation, treatment and coating of metals
3140	Manufacture of structural metal products
3150	Boilermaking, manufacture of reservoirs, tanks and other sheet-metal containers
3160	Manufature of tools and finished metal goods, except electrical equipment
3210	Manufacture of agricolture machinery and tractors
3220	Manufacture of machine-tools for working metal, and of other tools and equipment for use with machines
3230	Manufacture of textile machinery and accessories; manufacture of sewing machines
3240	Manufacture of machinery for the food, chemical and related industries
3250	Manufacture of plant for mines, the iron and steel industries and foundries, civil engineering
3260	Manufacture of transmission equipment for motive power
3270	Manufacture of other machinery and equipment for use in specific branches of industries
3280	Manufacture of other machinery and equipment
3300	Manufacture of office machinery and data processing machinery
3410	Manufacture of insulated wires and cables
3420	Manufacture of electrical machinery
3430	Manufacture of electrical apparatus and appliances for industrial use
3440	Manufacture of telecommunications equipment, electrical and electronic measuring and recording equipment
3450	Manufacture of radio and television receiving sets, sound reproducing and recording equipment and of electronic equipmen
3460	Manufacture of domestic type electric appliances
3470	Manufacture of electric lamps and other electric lighting equipment
3510	Manufacture and assembly of motor vehicles (including road tractors) and manufacture of motor vehicle engines
3520	Manufacture of bodies for motor vehicles and of motor-drawn trailers and caravans
3530	Manufacture of parts and accessories for motor vehicles
3610	Shipbuilding
3620	Manufacture of standard and narrow-gauge railway and tramway rolling-stock
3630	Manufacture of cycles, motor-cycles and parts and accessories thereof
3640	Aerospace equipment manufacturing and repairing
3650	Manufacture of transport equipment not elsewhere specified
3710	Manufacture of measuring, checking and precision instruments and apparatus
3720	Manufacture of medical and surgical equipment and orthopaedic appliances (except orthopaedic footwear)
3730	Manufacture of optical instruments and photographic equipment
4110	Manufactures of vegetables and animal oils and fats
4120	Slaughtering, preparing and preserving of meat (except the butcher's trade)
4130	Manufacture of dairy products
4140	Processing and preserving of fruit and vegetables
4150	Processing and preserving of fish and other sea foods fit for human consumption
4160	Grain milling

Table 1A - 3-digit NACE sectors included in the sample

NACE code	Description
4170	Manufacture of spaghetti, macaroni, etc.
4180	Manufacture of starch and starch products
4190	Bread and flour confectionery
4200	Sugar manufacturing and refining
4210	Manufature of cocoa, chocolate and sugar confectionery
4220	Manufacture of animal and poultry foods (including fish meal and flour)
4230	Manufacture of other food products
4240	Distilling of ethyl alcohol from fermented materials; spirit distilling and compounding
4250	Manufactures of wine of fresh grapes and of beverage base thereon
4270	Brewing and malting
4280	Manufactures of soft drinks, including the bottling of natural spa waters
4290	Manufacture of tobacco products
4360	Knitting industry
4380	Manufacture of carpets, lineolum and other floor coverings, including leathercloth and similar supported synthetic sheeting
4390	Miscellaneous textile industries
43A+43B	Wool, Cotton, Silk, Jute, Preparation, spinning and weaving of flax, hemp and ramie, jute
4410	Tanning and dressing of leather
4420	Manufacture of products from leather and leather substitutes
4510	Manufacture of mass-produced footwear (excluding footwear made completely of wood or of rubber)
4530	Manufacture of ready-made clothing and accessories
4550	Manufacture of household textiles and other made-up textile goods (outside weaving-mills)
4560	Manufacture of furs and of fur goods
4610	Sawing and processing of wood
4620	Manufacture of semi-finished wood products
4630	Manufacture of carpentry and joinery components and of parquet flooring
4640	Manufacture of wooden containers
4650	Other wood manufactures (except furniture)
4660	Manufacture of articles of cork and articles of straw and other plainting materials (including basketware and wickerwork); m
4670	Manufacture of wooden furniture
4710	Manufacture of pulp, paper and board
4720	Processing of paper and board
4730	Printing ad allied industries
4810	Manufacture of rabber products
4830	Processing of plastics
4930	Photographic and cinematographic laboratories
4940	Manufacture of toys and sports goods
4950	Miscellaneous manufacturing industries

Table 2A - Manual and non-manual employment, turnover and trade flows by sectors Italy -1993

NACE code	Manual	Non-manual	Turnover[a]	Exports[a] to LACs	Imports[a] from LACs
2600	11715	3629	2088.4	117.477	112.601
3110	27429	6209	3401.8	72.305	33.865
3120	16765	4470	3126.7	98.347	13.54
3130	37791	8400	4430.4	85.29	35.411
3140	48476	12630	6183.8	287.462	7.921
3150	12658	3986	1905.8	254.649	7.962
3160	52474	15760	8468.1	909.969	175.475
3210	19423	7592	3295.8	268.39	12.235
3220	33011	17547	5311.8	832.773	72.365
3230	11986	5916	2009.3	1097.495	35.573
3240	25563	18363	5988.1	1902.014	37.37
3250	32478	18138	7676	1841.238	64.076
3260	17230	6666	2549.2	148.376	85.174
3270	15651	7733	2829.4	904.875	25.692
3280	56237	31518	11540.9	4266.062	177.51
3300	8106	27780	9378.2	293.237	600.32
3410	10697	3831	2901.5	169.937	23.826
3420	30561	15277	5246	862.825	248.3
3430	25867	13831	4434.2	366.237	117.131
3440	27487	34755	8232.7	404.577	124.265
3450	25698	22416	6752.3	760.458	900.821
3460	36663	9629	6857.6	588.953	93.131
3470	6680	2808	1460.8	27.995	31.833
3510	105212	36321	21548.9	1246.403	496.54
3520	13244	3288	2059.1	43.889	8.266
3530	38083	10587	5555.7	745.478	60.262
3610	21564	6766	2825.2	657.047	26.051
3620	9639	3083	1023	33.815	3.892
3630	12784	4084	2037.3	124.708	128.794
3640	23681	23255	4492.9	354.767	302.941
3650	1294	229	197.7	9.144	3.849
3710	5840	4000	1146.4	25.546	15.979
3720	5982	3660	1010.6	33.976	7.738
3730	9399	3776	1272.9	159.405	73.426
4110	2922	1840	3649.9	88.982	464.241
4120	29944	5794	10063.3	170.205	522.774
4130	22856	15423	10393.8	21.293	3.449
4140	16754	4304	4127.5	157.799	176.864
4150	3279	704	817.9	16.806	308.795
4160	3465	1380	2432.4	243.056	2.06

[a] Millions of ECU

Table 2A - Manual and non-manual employment, turnover and trade flows by sectors Italy -1993

NACE code	Manual	Non-manual	Turnover[a]	Exports[a] to LACs	Imports[a] from LACs
4170	6984	1907	2561.3	118.635	0.488
4180	990	417	379.5	9.702	0.918
4190	15739	3286	3033.5	55.517	1.264
4200	13155	5396	3853.8	75.553	29.404
4210	2426	1166	791	80.172	13.657
4220	4426	3797	4304.4	138.567	43.19
4230	7724	5325	3765.9	49.248	19.732
4240	2839	2823	2135.7	61.353	6.867
4250	5038	2529	2048.5	48.643	1.253
4270	2912	1485	1128.8	4.15	9.333
4280	6575	2531	2472.8	15.95	1.59
4290	14115	3824	6781.6	3.878	0.364
4360	48952	10292	7732.1	486.078	537.186
4380	2773	691	429.2	126.949	131.143
4390	11387	2918	1552.6	113.04	50.137
43A+43B	112267	41874	17002.2	1293.039	819.089
4410	12596	2564	3060	716.7	538.446
4420	9939	2000	1313.7	175.666	192.458
4510	65894	7807	7140.9	878.321	664.016
4530	133831	22919	14365.9	726.446	1238.854
4550	7023	1915	1161.1	40.63	174.63
4560	1119	252	107.2	16.633	48.998
4610	2565	594	482.4	12.249	343.943
4620	8561	1637	1489.5	65.395	107.458
4630	10434	2120	1418.4	20.293	99.991
4640	4477	563	492.8	0.947	0.718
4650	4123	950	615.4	23.867	77.39
4660	1789	801	235.6	5.296	44.702
4670	55057	14205	8207	2.471	17.069
4710	17147	4747	3865.4	133.241	285.122
4720	29667	8879	6234.3	222.495	37.028
4730	36172	13254	5267.9	78.021	14.907
4810	35268	10412	5165.4	258.019	220.737
4830	68355	20220	12339.1	599.882	153.334
4930	2113	1365	328.9	2.948	0.536
4940	4154	1106	626.7	0.968	0.168
4950	3096	816	305.4	3.118	32.593
Total	1688270	636765	324919.2	27357.34	11601.031

[a] Millions of ECU

Chapter 4: Vertical disintegration and the labour market effects of international trade. The case of Outward Processing Trade between the European Union and Central Eastern European countries

1. Introduction

The objective of this chapter is to investigate the implications for labour markets of the on-going liberalisation process involving trade between EU countries and Central and Eastern European countries (CEEC), by an approach addressed to study vertical forms of integration in EU-CEEC trade. In particular, outward processing traffic (OPT) will be treated.

In studies which have attempted to predict the future evolution of trade with Eastern European countries and its impact on European welfare (Collins and Rodrick, 1991; Wang and Winters, 1992; Hamilton and Winters, 1992; Baldwin, 1993), a clear definition of the pattern of trade of the CEE economies has not emerged (because of the present phase of transition in these countries), and consequently the estimates of the impact of trade are uncertain. Also the authors using general equilibrium models to estimate the effect of CEEC trade on EU economies have complained about a lack of strong results due to the models' inability to capture intra-sectoral adjustments (Gasiorek, Smith and Venables, 1994). In this regard, Adrian Wood (1994) warns against the risk of understating the effects of trade on labour markets if product heterogeneity is not adequately defined. Following Wood's suggestion, the previous chapter offered a new treatment of the labour market effects of international trade, based on a model in which intra-industry trade is explained by differences in skill intensity associated with the quality differentiation of traded goods. The model turned out to be more consistent with the stylised facts about North-South trade than the traditional Heckscher-Ohlin model of inter-industry trade. The application of the model to trade between Italy and 'less advanced countries' revealed that the labour market effects of intra-industry trade add significantly to the estimated factor market impact of trade.

So heterogeneity in intra-industry trade is important. But not only in terms of the quality of final goods but also in terms of the fragmentation of productive processes. Recently, Feenstra (1998) has discussed the importance of outsourcing in the unskilled-adverse shift in labour demand occuring in advanced countries in recent years. Trade flows deriving from the vertical disintegration of production on an international scale could have the same within-industry effects as technology on the displacement of demand for unskilled workers. But usually economists assume that international trade has an impact on labour markets via between-industry adjustments, ignoring the complementarities between trade and technology that are so evident in the recent dynamics of vertical disintegration arising in advanced countries.

OPT is a type of vertical disintegration in international trade which is becoming a main channel of interdependence between EU countries and CEE countries (Corado, 1994). Therefore, if the study of labour market effects of EU-CEEC trade is carried out looking at forms of vertical trade like OPT, a better assessment of the adjustment problem could be achieved. The standard theory of international trade (HOS approach) used normally to estimate the impact of trade on labour markets assumes that each product traded is associated with a unique industry with a unique production process. This assumption is crucial to formulate estimates of the distributional effects of trade consistent with factor ratio variations (Stolper-Samuelson theorem). But, in reality, an industry may produce a good using processes which differ in their factor intensity. In addition, particular production processes of an industry could be transferred abroad in order to exploit, for example, the availability of cheaper foreign labour.

In this chapter I introduce the dimension of vertical disintegration in the treatment of the labour market effects of international trade. Specifically I make an attempt to evaluate the differential impact of OPT flows with respect to final flows on the labour markets of EU countries. Two EU countries are investigated, Germany and Italy, because of their importance in total EU-CEEC OPT flows and because they embody two different models of outsourcing towards CEECs. The factor content of trade (FCT) analysis conducted both at inter-industry trade and intra-industry trade level shows a more significant impact of OPT flows than final flows. In particular, results suggest that the labour market effects of intra-industry trade flows deriving from the vertical disintegration of production add significantly to the estimated factor market impact of trade.

The chapter is structured in five sections. Section 2 provides a short discussion of EU trade policy in textile and clothing, focussing on the preferential regime granted to OPT. Section 3 offers a short overview of OPT in the EU from which it is possible to extrapolate the reasons to focus the analysis on EU-CEEC trade. Section 4 first presents a short reconstruction of the debate on trade and jobs, where the relevance of vertical trade - in both senses of outsourcing and quality differentiation – is emphasised in order to explain the unskilled-adverse shift in labour demand in advanced countries. Then it provides an empirical application to test the differential impact of OPT flows with respect to final flows. The final section contains some concluding remarks.

2. The EU trade policy in textile-clothing and the OPT system

Outward Processing Traffic (OPT) refers to trade flows associated with a particular form of sub-contracting carried out by EU firms on an international scale. The sub-contracting agreement involves an EU contractor who temporarily exports a commodity to be processed abroad by a sub-contractor and then re-imported. The contract provides that the ownership rights over the input supplied are retained by the contractor who is committed to collect his output after processing; the contractor also retains the right to market the final product or to process the reimported product further as necessary[40].

In comparison with a mere sub-contracting agreement, OPT benefits from a preferential trade regime in the EU[41]. On this regard we have to distinguish *fiscal OPT* from *economic OPT*[42]. The first term refers to EC customs regulation 2473/86 which establishes that duties are paid only on the added value of re-imported goods. Firms using fiscal OPT must apply for specific authorisations and declare re-imports as OPT. Since 1993, under Europe Agreements[43], tariffs on OPT flows in textile and clothing have been suppressed totally, while normal reimports under Multi-fiber Arrangement (MFA)

[40] In addition, the contractor maintains the right to carry out quality control and to reject the sub-contractor output on the basis of quality, timing of delivery and other contractual conditions.
[41] For legal aspects of the OPT arrangement see Pellegrin (1995).
[42] Cfr. Scheffer (1994).
[43] Since March 1992 the EU has signed association agreements with Poland, Hungary, the Czech Republic and Slovakia, followed in April 1993 similar agreements with Romania and Bulgaria. This

quotas continued to be regulated by current tariffs. The second term refers to a specific regime to clothing (as established by EC regulation 636/82) according to which OPT requires the use of fabrics of EC origin. For East European countries, duties at the 0% rate are granted on re-importation, after OPT, of certain products listed in the Annex of EC Regulation 636/82. The 1982 regulations established an *ad hoc* regime for OPT under which specific OPT quotas were reserved to producers carrying out outward processing, while before 1982 OPT flows were regulated by Multi-fiber Arrangement for global textile and clothing. On 1 January 1993, the European single market has replaced the national quota with a single "Community" quota[44].

The intent of the regulations was to defend textile-clothing industry employment in the EU while by offering a means by which the industry can adapt to competition from direct imports (Scheffer, 1994). Although OPT of textile and clothing from the EU to CEECs boomed after 1990, the phenomenon is not new. Almost 30 years ago, long before the crash of COMECON, German producers especially started to implement outward processing in Yugoslavia, Poland and other Central Eastern Eurpean countries (Frobel, Heinrichs and Kreye, 1980)[45]. OPT was the reaction of the clothing industry to the sharp increase of imports from low cost countries in spite of the protection provided by Multi-Fibre Arrangement (MFA). These developments in the restructuring of textile-clothing industry in the EU have gone with the change in the institutional framework of protection provided by EU trade policy in the form of a quicker relaxation of OPT quotas than non-OPT quotas.

Since 1974, import penetration in developed countries' markets has been regulated by MFA. Under this agreement, quantitative restrictions on imports into developed countries were negotiated on a bilateral basis. The quota system authorized the amount of imports on which specific tariffs of each importing country were applied, with provisions for annual increase in the quotas that differ across importing countries. In the case of EU countries, before the completion of the single European market, quotas were allocated to countries by the European Commission on the basis of previous trading patterns[46]. In doing so, the Commission aimed to prevent market disruption and to encourage freer trade among new entrants[47]. Despite its pervasive protection, MFA failed to prevent the dramatic increase of extra-EU imports. According to Steele (1995), the same completion of single Market - with the abandonament of the EU's quota allocation system and with the introduction of a single Community quota in 1993 - could have contributed to rising textile and clothing imports from extra-EU countries through the "emergence of distributors able to operate on a pan-European scale… and to place very large orders, thus taking full advantage of low cost sources of supply outside the EU". Ginzburg and Simonazzi (1995) also have noted a strict correlation between a member state's propensity to import and the organization of its clothing distribution structure: "…Where the distributive sector was too weak in comparison with the power of distribution, like in the UK, the struggle resulted in early and intense relocation of production linked to outsourcing in the low-cost countries of the Far East. Where the distributive sector was weaker (less concentrated) and the manufacturing system was relatively strong two radically different strategies emerged. The high cost firms in Germany relied on international subcontracting of the more labour-intensive stages of

[44] Cfr. Graziani (2001).
[45] Thanks to tariff provisions similar to the European OPT system, also US producers started in the sixties to use outward processing. Under the US 9802 Special Tariff System, in recent years US textile and clothing outward processing trade with Mexico and the Caribbean countries has boomed (cfr. G.Graziani, 2001).
[46] Cfr. Steele (1995).
[47] For example, when Spain and Portugal joinen the EU in 1986, they were allocated very small shares of Community-wide quotas in line with their former trading patterns. Cfr. Steele (1995).

production, in the neighbouring Mediterranean and East-European countries. Italian firms pursued a strategy of quality up-grading based on a process of national subcontracting"[48].

So, in the nineties, the increasing recourse to OPT and the preferential trade regime supporting this practice in the EU could be interpreted as a defensive response of EU textile and clothing firms to the growing competition of extra-EU low cost countries. The Europe Agreements were in line with this strategy. For trade in textile and clothing, they established a liberalisation at twice the rate of the multilateral liberalisation negotiated in the Uruguay Round[49]. Furthermore, the Europe Agreements aimed to "construct a vertically integrated international sector encompassing high value-added phases located domestically as well as low-cost sourced operations abroad" (Ginzburg and Simonazzi, 1995, p. 9). The protocols concerning textile and clothing involved the following terms: an increase in the volumes of quotas and their rates of growth, the total suppression of certain quotas (with timing linked to the MFA), the removal of customs duties on OPT, the removal of tariffs on direct imports of six years[50].

So the elimination of EU tariffs on OPT imports from the CEECs might explain the boom of OPT flows between the EU countries and the CEECs in the nineties. However, OPT as a tariff system may become less important after 1998 with the transition to a trade regime in which tariff barriers on non-OPT flows are removed also. After 1998, OPT regulations no longer require production of fabrics in EU countries; so EU firms can freely import garments incorporating fabric made in CEECs (Graziani, 2001).

3. An overview of OPT flows in EU countries

The statistical regime instituted in order to monitor OPT allows one to observe the international disintegration of production in EU during the nineties. The fact that OPT has to be declared to the custom authorities allows Eurostat to process data distinguishing different statistical regimes: 1) *exports for* and *imports after* outward processing, 2) *exports after* and *imports for* inward processing, 3) *normal* exports and imports[51]. The Eurostat-Comext data set provides information on OPT flows and final trade flows at a very high level of product disaggregation since 1988 for each EU reporting country. Although OPT data describes only a part of the vertical disintegration of production at the international level, it can offer a useful preliminary description of this phenomenon.

Table 1 reports a comparison between OPT flows and final flows with reference to Extra-EU trade of EU countries. Although the OPT flows still represent a small fraction of final flows, they grew at a faster pace. From 1989 to 1997 the OPT flows of the whole EU area have increased more than 160%, whereas final flows have risen by 63%. Only in three countries (Netherlands, Spain and Portugal) is the rate of growth of final flows higher than that of OPT flows. So, on the whole, OPT data from EU countries confirms the increasing importance of vertical flows in world trade as reported in several recent studies[52].

[48] However, in recent years Italy has increased its recourse to OPT. The rising relocation of Italian garment production has been acknowledged by the Italian government. In fact, restrictions on outward processing have been relaxed from 15% of total output to 30% (cfr. Ricchetti,1993).
[49] Cfr. Smith (1994).
[50] See Lewis (1995), p. 62, and Winters (1992).
[51] With regard to OPT flows, in the present context we are interested in flows at point 1, because the analysis focuses on the relocation of the production segments from EU countries to CEEC.
[52] Hummels, Rapoport, Kei-Mu Yi (1998), Feenstra (1998). For a theoretical discussion on the insertion of vertical fragmentation in trade models, see Deardorff (1998).

Table 1 - Comparison between opt flows and final flows in Extra-EU trade of EU countries. 1989-1997

	1989				1997				1997/1989	1997/1989	1989	1997	1997/1989
	(x1000 Ecu)				(x1000 Ecu)				M+X	M+X	M+X	M+X	M+X
	Final Flows		Opt Flows		Final Flows		Opt Flows		Final flows	Opt flows	Opt share	Opt share	Opt share
	Import	Export	Import	Export	Import	Export	Import	Export					
001 FRANCE	38408307	43906492	1023394	974780	51909106	68533166	2122262	2543652	1,46	2,34	2,43%	3,87%	1,60
002 BELGIUM AND LUX	21128990	17935347	112563	145795	30703795	28578795	707821	378204	1,52	4,20	0,66%	1,83%	2,77
003 NETHERLANDS	20798829	12062585	1086086	730648	47220779	23205991	995127	1255950	2,14	1,24	5,53%	3,20%	0,58
004 GERMANY	87319777	116310815	2708565	2113568	1,15E+08	1,61E+08	7485380	5950654	1,35	2,79	2,37%	4,87%	2,06
005 ITALY	38377899	47698493	575803	578285	47968401	83281971	1572890	1514140	1,52	2,67	1,34%	2,35%	1,75
006 UNITED KINGDOM	64032366	48693038	358708	465346	91106976	79005051	985319	1659693	1,51	3,21	0,73%	1,55%	2,13
007 IRELAND	3292652	2241827	708	29294	7300189	7858383	11190	143173	2,74	5,15	0,54%	1,02%	1,88
008 DENMARK	8390874	8636157	170007	127840	7559112	9138400	366913	254257	0,98	2,09	1,75%	3,72%	2,13
009 GREECE	3646106	763809	589	2438	5211444	2545726	62827	120206	1,76	60,47	0,07%	2,36%	34,38
010 PORTUGAL	2789465	2425735	7971	8051	3900900	2920754	5616	14824	1,31	1,28	0,31%	0,30%	0,98
011 SPAIN	13986908	11282246	222830	143925	17240759	19171896	123466	159995	1,44	0,77	1,45%	0,78%	0,54
030 SWEDEN	0	0	0	0	12722997	29847424	180994	370047	/	/	/	1,29%	/
032 FINLAND	0	0	0	0	5777174	13586332	109490	286806	/	/	/	2,05%	/
038 AUSTRIA	0	0	0	0	10405463	16340209	391976	454442	/	/	/	3,16%	/
EU15	302172173	311956544	6267224	5319970	4,54E+08	5,45E+08	15121271	15106043	1,63	2,61	1,89%	3,03%	1,60

Source: Comext

Table 2 shows that in 1989 the main users of OPT were five countries: Germany, France, the Netherlands, Italy and the UK. The first one accounted for more than 40% of total EU OPT flows, France and the Netherlands followed with shares of more than 17% and 15% respectively, then Italy and the UK with shares below 10%. In 1997 the rank of main users changed because of the sharp drop in the Netherlands' OPT: now only Germany, France and Italy display shares higher than 10%.

Tab 2 - Main users of opt in EU 1989, 1997

	Imports+Exports (Extra-EU) millions of ECU		OPT Shares	
	1989	1997	1989	1997
001 FRANCE	1.998	4.666	17,24%	15,44%
002 BELGIUM AND LUX	258	1.086	2,23%	3,59%
003 NETHERLANDS	1.817	2.251	15,68%	7,45%
004 GERMANY	4.822	13.436	41,62%	44,45%
005 ITALY	1.154	3.087	9,96%	10,21%
006 UNITED KINGDOM	824	2.645	7,11%	8,75%
007 IRELAND	30	154	0,26%	0,51%
008 DENMARK	298	621	2,57%	2,05%
009 GREECE	3	183	0,03%	0,61%
010 PORTUGAL	16	20	0,14%	0,07%
011 SPAIN	367	283	3,17%	0,94%
030 SWEDEN	0	551	0,00%	1,82%
032 FINLAND	0	396	0,00%	1,31%
038 AUSTRIA	0	846	0,00%	2,80%
EU15	11.587	30.227	100,00%	100,00%

Source: Comext

When the sectoral composition of OPT flows is considered, we can observe that only three main aggregates account for more than 80% of total manufacturing industry flows: Machinery (electrical and non electrical, CN 84 and 85), Textiles-apparel (CN 50-63) and Transport (CN 86-89).

In particular, the first column of table 3 shows that in 1989 Machinery accounted for more than 40% of OPT between EU and Extra-EU countries, while Textile-apparel and Transport accounted for 33% and 7% respectively. In 1997 the weight of the Textile-apparel sector has increased further. Interestingly, this sectoral concentration of OPT flows links up with a geographical specialisation, indicating a straightforward international division of labour.

Table 3 - Sectoral composition and geographical distribution of EU OPT flows. 1989-1997.

Percentage shares

	1989						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	33%	29%	9%	62%	0%	0%	100%
Mec-Elect	41%	2%	44%	3%	46%	5%	100%
Transport	7%	3%	1%	14%	82%	0%	100%
Others	19%	11%	8%	41%	38%	1%	100%
Total Manuf	100%	11%	26%	26%	34%	3%	100%
	1997						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	37%	12%	6%	82%	0%	0%	100%
Mec-Elect	38%	2%	52%	21%	23%	2%	100%
Transport	9%	2%	1%	8%	88%	1%	100%
Others	16%	5%	10%	53%	30%	1%	100%
Total Manuf	100%	6%	25%	46%	22%	1%	100%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

I

n particular, table 3 shows that OPT flows in the Textile-apparel sector are almost entirely channelled to CEECs, Transport OPT flows are mostly directed to North America and OPT flows in machinery are concentrated (to a lesser extent) in Far Eastern countries. Globally, the CEEC area is becoming the main pole of attraction of EU OPT flows, accounting for 50% of total OPT. This tendency to a sectoral/geographical polarisation of OPT flows is even more evident when we look at a single EU country. For example, in the case of Germany and Italy in 1997 a great part of their total OPT flows (60% and 70 % respectively) was concentrated on the CEEC area and in the Textile-apparel sector, while in the case of France and the Netherlands OPT flows were mostly oriented towards Far East Asian countries in the Machinery sector (see country tables in annex).

This evident correlation between geographical and sectoral specialisation in OPT flows testifies not only to a strong international division of labour based on comparative advantages but also to links between countries due to the spheres of influence factors[53].

However, when we look at the relevance of OPT flows in comparison with the final trade flows at the sectoral and geographical level we can note that only in the case of the CEEC area and in the Textile-apparel sector is the weight of OPT remarkable. Table 4 reports the ratio of OPT flows to final trade flows and shows that only in the case of the CEECs in Textile-apparel is the ratio bigger than one.

[53] Roemer (1977) has highlighted the role of sphere of influence factors in world trade by crossing sectoral and geographical specialization of main advanced countries. An example of sphere of influence factors acting in OPT is represented by France OPT flows in Textile-apparel. In 1989 a large proportion of those flows were oriented to North Africa, indicating an evident Roemer-type link between the country and a geographical area characterized by previous colonial relationship with France.

For this reason in the next section, after a short reconstruction of the debate on trade and jobs, we try to evaluate the differential labour market impact of OPT flows with respect to the final flows by looking at CEECs in the textile-apparel sector. Given that Germany and Italy assemble the main part of EU OPT in CEECs in Textile-apparel (60% and 15% respectively), the trade impact will be measured with reference to the labour markets of these two countries.

Table 4 - OPT flows/final flows ratio. Total EU

(Imports+Exports, thousand of ECUs)

	1989					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	8%	14%	2%	107%	0%	0%
Mec-Elect	3%	1%	7%	3%	4%	3%
Transport	1%	0%	0%	7%	3%	0%
Total 3	3%	4%	5%	24%	4%	2%
Total Manuf	2%	2%	3%	14%	2%	1%
	1997					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	15%	10%	2%	114%	0%	1%
Mec-Elect	3%	2%	6%	7%	3%	1%
Transport	2%	1%	0%	1%	7%	0%
Total 3	5%	4%	5%	19%	4%	1%
Total Manuf	3%	2%	3%	12%	2%	1%

Source: Comext

4. The impact of OPT on labour markets

4.1 Trade and labour markets: an open issue

In the previous chapter we have remarked that the prevailing idea emerging in the debate on globalisation and jobs is that the adverse shift in labour demand for unskilled workers which has occurred in OECD countries over the last two decades has to be attributed to technological change rather than international trade. This conclusion mainly derives from the inconsistencies stressed by trade theorists between the standard model of international trade (HOS model) and the empirical evidence concerning the industrial adjustment in the United States.

However we have also stressed the risk of understating the effects of trade on labour markets if product heterogeneity is not adequately examined or, in other words, if the role of “non-competing trade” is disregarded. We have offered a new perspective of analysis in which the labour market effects of two forms of non-competing flows are evaluated: i) trade which is intra-industry but inter-product, ii) IIT with quality product differentiation. We found that the impact of these two types of trade is significant.

Recently Feenstra (1998) has emphasized that another important source of underestimation of the labour market effect of international integration is the lack of an adequate consideration of the vertical disintegration of production within-industry on international scale:

"…Outsourcing has a qualitative similar effect on reducing the demand for unskilled relative to skilled labor within an industry as does skilled-biased technological change. This insight has several important implications. First, we should not assess the proximate cause of the decline in employment and wages of unskilled workers by attributing all within-industry shifts in labor demand to technology, and allowing trade to operate only via between-industry shifts. This was the approach taken by Lawrence and Slaughter (1993) and Berman, Bound and Griliches (1994), both of whom considered only trade in final goods. In that context, it is correct that international trade must affect labor demand through interindustry shifts. But as soon as trade in intermediate inputs is permitted, as with outsourcing, then changes in the demand for labor within each industry can occur due to trade, as well…[54]*"*

Conceptually, the observation of Feenstra about the labour market impact of trade flows originating from international fragmentation of production is important but the implementation of empirical estimates about this phenomenon represents a very difficult task, given the lack of systematic information about the international relocation processes acting within-industry. In this paper we offer an attempt to deal with this empirical issue. The availability of a powerful data set for EU countries (Eurostat-Comext) distinguishing OPT - a form of vertical trade - from final flows and of an empirical methodology able to estimate the factor content of intra-industry trade together permit a quantitative measurement of the impact of vertical trade. In the previous chapter, the calculation of the factor content of IIT focussed on flows of final goods for the reason that the emphasis was focussed on quality differentiation. Now the analysis of labour market effects of IIT goes further and the FCT methodology at the 8 digit level is applied to a new data set relating to trade flows of a different nature in comparison with final flows, specifically trade flows originating from vertical fragmentation of production. We expect that the labour market effects of OPT are larger than final flows since it is reasonable to assume that EU firms relocate the less skill intensive segments of production to CEECs.

In the previous section of this chapter we observed that the OPT share of trade flows is trivial in aggregate but it is relevant in specific sectors and markets. In the case of CEECs in the Textile-apparel sector OPT flows are even bigger than final flows. So any attempt to calculate the effects of EU trade with CEECs on EU labour markets has to give this aspect due consideration. In the next section we try to estimate the differential impact of OPT flows in comparison with final flows by looking at EU trade with CEECs in the Textile-apparel-footwear-leather sectors. It seems to us that the interest of this empirical application is twofold: on the one hand it represents a way to treat, at the empirical level, an important analytical issue that has recently emerged in the debate on trade and jobs; on the other hand it gives the opportunity to transpose the debate on "liberalization and the labour markets", developed in the late 1980s and the 1990s especially in the US, to the EU with particular regard to the dynamics of integration with CEE countries.

4.2 An empirical application

4.2.1 The structure of trade flows

A preliminary investigation of the link between trade and labour markets requires us to look carefully at the nature of trade flows. In other words, a useful task is to identify the share of trade flows which has an impact on labour markets. Obviously, in this task the level of aggregation matters. If we adopted a conventional approach based on the Heckscher-Ohlin model of inter-industry trade applied to three-digit sectors we would exclude from FCT calculations the share of trade consisting of intra-industry flows (IIT), that is to say offsetting flows of imports and exports within 3-digit sectors which have zero

[54] Feenstra (1998), page 41.

effect in the factor content calculation. But in following the conventional wisdom we risk an underestimation of the trade impact because of the part of IIT flows which, on the contrary, could have a labour market effects. This part consists of: 1) inter-product flows within-industry, 2) intra-product flows differentiated by quality.

In order to take account of the two types of trade flows disregarded in conventional FCT studies, we have calculated: 1) IIT indices at the 3 and 8 digit level to evaluate to what extent the level of aggregation hides inter-product trade; 2) 8-digit IIT indices distinguishing vertical and horizontal components in order to single out 2-way trade flows differentiated by quality. We follow Abd-el-Rahman, 1991, Torstensson, 1991, Landesmann and Burgstaller (1997) and Fontagné et al. (1998) in using differences between the unit values of imports and exports of products in the same 8-digit class to distinguish between horizontal and vertical intra-industry trade. If the unit values of imports and exports diverge by more than 15%, this is taken as indicating that imports and exports are of different qualities so that there is vertical intra-industry trade (VIIT); while differences of less than 15% indicate horizonal intra-industry trade (HIIT). One can further distinguish between 'VIIT+' trade, where the unit values of the export flow are greater (by at least 15%) than the import unit value; while 'VIIT-' trade describes the case where it is import unit values that are larger.

Intra-industry trade indices have been calculated in the case of German and Italian trade with CEECs in 1997. The sectors considered belong to the aggregate Textile-apparel-footwear-leather[55]. The trade structure emerging from the calculation of IIT indices is reported in the four figures below. Figures 1 and 2 refer to final flows (proxied by non-OPT flows) of Germany and Italy respectively. Figures 3 and 4 concern OPT flows for the same countries.

4.2.2 The structure of final trade flows

In the case of German final flows (figure 1), IIT calculated at 3-digit level represents 55% of total trade. This means that inter-industry trade, that is HO-type trade, corresponds to 45% of total flows. But if we calculate the Grubel-Lloyd index at the 8-digit level, then the 2-way trade drops to 31%; consequently HO trade rises to 69%, indicating that the 3-digit calculation hides 24% of trade flows which is inter-product trade (that is IIT at the 3-digit but HO trade at the 8-digit).

In addition, if we divide the 8-digit Grubel-Lloyd index (31%) into the vertical and horizontal components, we see that trade flows differentiated by quality predominate (VIIT = 25%, HIIT = 6%)[56]. Only a small residual fraction of total trade, HIIT = 6%, has no effect on labour markets: a quite different number from that deriving from a mere conventional 3-digit calculation (IIT = 55%).

Figure 2 shows that the structure of Italian final flows is quite similar to the case of Germany and no particular comment needs to be made. In the end, the analysis of trade structure with reference to final flows suggests that the level of aggregation is important and that any FCT calculation has to hold this aspect in due consideration. This conclusion is in line with results obtained in the case of Italian manufacturing trade with less advanced countries.

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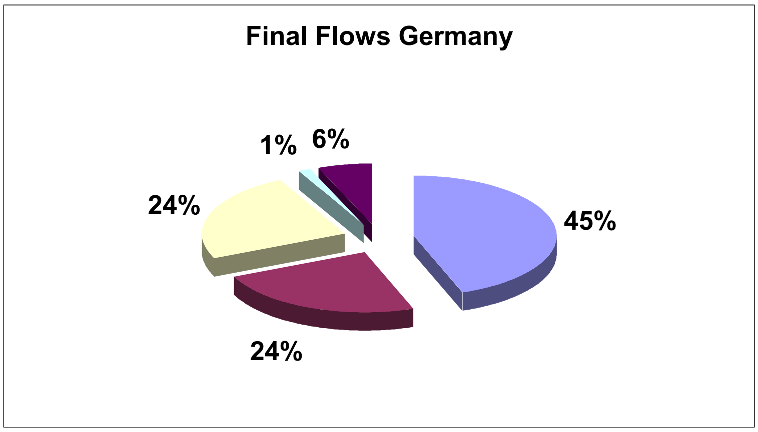
[55] We consider 10 3-digit NACE sectors and all 1588 8-digit products beloging to those sectors.

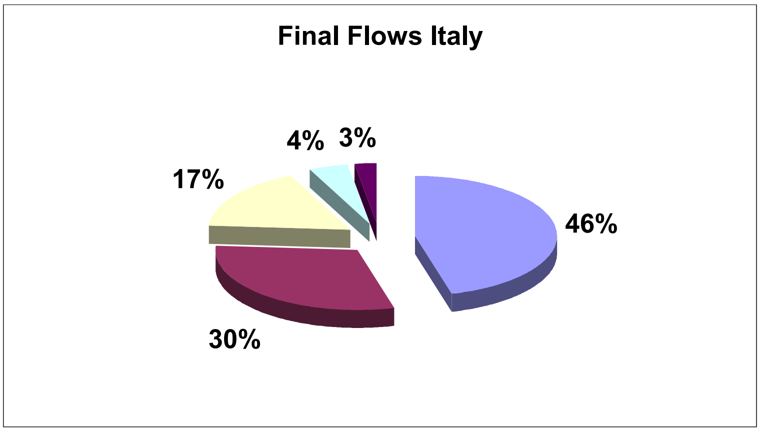
[56] VIIT can be further divided into $VIIT^+$ and $VIIT^-$. The first component indicates trade flows where UVs of exports are bigger than UVs of imports. The second component refers to trade flows where it is UVs of imports that are larger. In figure 1, we note that $VIIT^+$ (24%) prevails over $VIIT^-$ (1%). This result is in line with what we expect for final trade flows between EU countries and CEECs, because it is reasonable to assume that the quality of EU exports of final goods is higher than the quality of CEEC exports of final goods. As discussed in the next section, this assumption has to be amended in the case of OPT flows.

Figure 1 – Structure of German trade with CEEC in Textile-apparel-footwear-leather sectors - Final flows – 1997



Legenda:
HO (3-digit) = **45%**
IIT (3-digit), HO (8-digit) = **24%**
$VIIT^{+}$ = **24%**
$VIIT^{-}$ = **1%**
HIIT = **6%**

Figure 2 – Structure of Italian trade with CEEC in Textile-apparel-footwear-leather sectors - Final flows – 1997



Legenda:
HO (3-digit) = 46%
IIT (3-digit), HO (8-digit) = 30%
$VIIT^{+}$ = 17%
$VIIT^{-}$ = 4%
HIIT = **3%**

4.2.3 The structure of OPT flows

When we apply the same trade structure analysis to OPT flows, we have to expect different results from those deriving from final flows. Although the methodology based on the computation of IIT indices at the 8-digit level turns out to be appropriate also in the case of OPT flows, we have to introduce some qualifications concerning the specific nature of this type of trade.

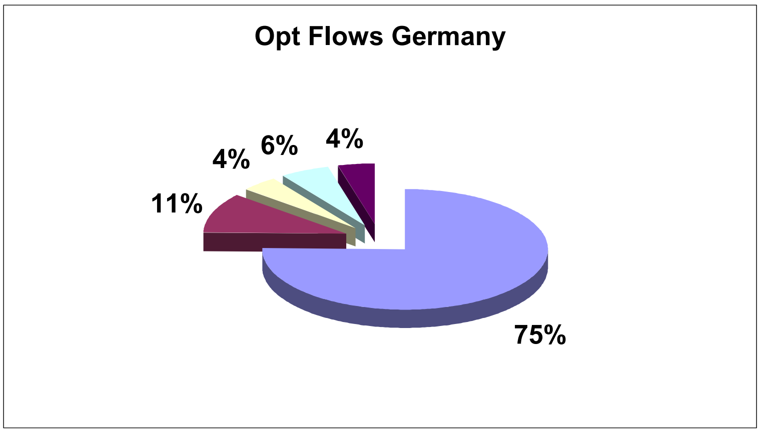
On the one hand it is reasonable to presume that the computation of inter-product trade at the 8-digit level allows us to capture, to some extent, vertical disintegration of production inside OPT flows. On the other hand the approach aiming to disentangle horizontal and vertical components inside IIT at the 8 digit level turns out to be more problematic to interpret when it is applied to the case of OPT flows. In EU-CEEC OPT the UVs of imports are higher on average than the UVs of exports. At first sight this seems puzzling because it would be more reasonable to assume that the quality of EU exports is higher than CEEC exports. However this result is not surprising because we are observing trade flows deriving from relocation of the phases of production abroad and not the trade flows of final goods. In other words, in the case of OPT in textile, apparel and leather, the difference between the export UV and the import UV of a particular 8-digit product could signal the fact that the commodity imported is more processed than the commodity exported, and not a mere example of quality differentiation as in the case of final goods[57].

This problem may be rather specific to textile, apparel, footwear and leather, where the successive stages of production are applied to a largely unchanged amount of physical material. In sectors such as electronics, with a less 'linear' production process we might well have high value, high quality components sent abroad for assembly into a lower unit-value final product.

The structure of OPT flows displayed in figures 3 and 4 confirms the qualifications above reported. Figure 3 shows that, in the case of Germany, even at the 3-digit level HO-type trade is the predominant part of total trade (75%). From this result we can also infer that an FCT calculation carried out at the 3-digit level will produce a balanced trade impact greater than that of final flows. Figure 3 also shows, although to a lesser degree than for final flows, that inter-product trade and VIIT augment HO trade (11% and 10% more respectively). As we expect for OPT flows, for the reasons above discussed, we note that $VIIT^{-}$ prevails in VIIT. In other words, 8 digit 2-way trade flows where the UVs of exports are lower than UVs of imports prevail over $VIIT^{+}$ (where it is the UVs of imports that are lower).

[57]We have calculated the ratio UV^M/UV^X at the 8-digit level and averaged for the total aggregate "Textile-apparel-footwear-leather" across 8-digit commodities in the case of final flows and OPT flows respectively. In both cases of Germany and Italy final flows show a ratio < 1 while OPT flows show a ratio > 1. This result is what we expect because final goods exported by Germany or Italy are on average more skill intensive than final goods imported from CEECs, while in OPT flows the intermediate goods exported from Germany or Italy to be processed in CEECs come back as imports with much added value reflected in a higher UV^M on average.

Figure 3 – Structure of Germany trade with CEEC in
Textile-apparel-footwear-leather sectors – OPT flows - 1997



Legenda:
HO (3-digit) = **75%**
IIT (3-digit), HO (8-digit) = **11%**
$VIIT^{+}$ = **4%**
$VIIT^{-}$ = **6%**
HIIT = **4%**

In the end, in the case of German OPT, analysis of the flow structure suggests that the trade impact might be more substantial than in the case of final flows but, at the same time, the level of aggregation seems to play a less relevant role in comparison with final flows.

However, when we look at Italian OPT flows, we observe that IIT is bigger than in the case of Germany (42% against 25%). This result confirms that the two countries have different models of outsourcing towards CEECs. In the case of Italy, a relevant proportion of the re-imports of apparel consists of products originally exported under the heading "apparel". In general, Italy relocates to CEECs the segments of the production process very close to the final stage of output, while Germany transfers to CEECs a broader spectrum of productive segments in order to re-import final goods[58].

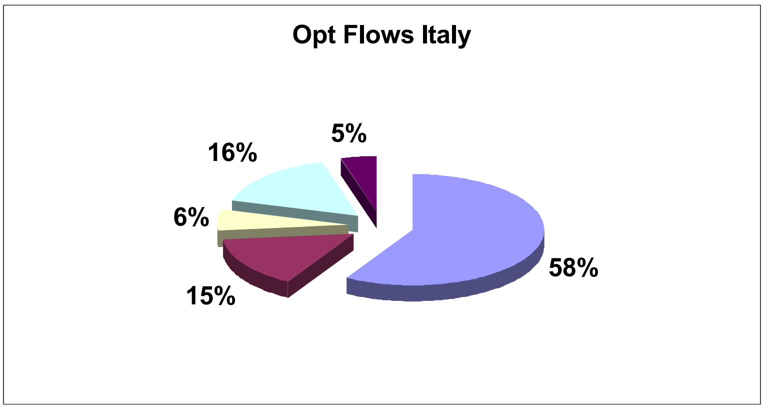
Therefore, given the higher level of IIT in OPT flows, in the case of Italy the issue of aggregation seems to play a more important role. In effect, figure 4 shows that IIT at the 3-digit level which is inter-product trade at the 8-digit level amounts to 15%. In addition VIIT (that is 8-digit 2-way trade flows differentiated by quality) adds up to 22%. Also in the case of Italy, $VIIT^{-}$ prevail over $VIIT^{+}$ but to a much greater degree than in the case of Germany (16% against 6%).

Especially in the case of Italy, the structure of OPT flows suggests that any evaluation of the labour market effects of OPT has to take account of the impact of IIT. As it will be illustrated in the next section, the FCT methodology based on the use of UVs at the 8-digit level in order to infer skill-intensity within industries, allows us to capture the labour

[58] Baldone Sdogati and Tajoli (1999).

market impact of inter-product trade that, in the context of OPT flows, represents a form of vertical disintegration of production.

Figure 4 – Structure of Italian trade with CEEC in Textile-apparel-footwear-leather sectors – OPT flows - 1997



Legenda:
HO (3-digit) = 58%
IIT (3-digit), HO (8-digit) = 15%
$VIIT^{+}$ = 6%
$VIIT^{-}$ = 16%
IIT = 5%

4.2.4 FCT analysis

In this section we try to evaluate the differential labour market impact of OPT flows in comparison with final flows. In particular, we compare results deriving from the 3-digit FCT calculation (conventional procedure) and those from the 8-digit computation. The two factors considered are skilled and uskilled labour. In the case of the 3-digit calculation, the availability of industry data (INDE data set with sectors defined according to NACE) enables us to obtain input coefficients: the proxy for the skilled labour (unskilled labour) coefficient is obtained as the ratio between non manual (manual) workers and turnover. At the 8-digit level no systematic industry data is available. Therefore we adopt the estimation procedure proposed in the previous chapter based on unit values of trade flows in order to compute input coefficients at the 8-digit level.

In the same way as in chapter 3, two types of FCT calculation are implemented. The first calculation (HO-8 method) attempts to calculate the labour market effects of trade that is measured as intra-industry trade at the 3-digit level but as inter-product trade at the 8-digit level by imputing labour input coefficients to each 8-digit commodity, but the same input coefficients to exports and to import substitutes. The second calculation (VIIT method) goes further: by imputing separate coefficients to exports and import substitutes, it allows for factor market effects from vertical intra-industry trade at the 8-digit level, that is from intra-product flows differentiated by quality.

The methodology above described has been applied to the case of Italy-LAC trade in final goods. How is the same approach to be interpreted when it is applied to the context of EU-CEEC OPT flows?

As discussed in the previous section, in the case of textile, apparel, footwear and leather OPT flows the probable negative difference between export UV and import UV of a particular 8-digit good doesn't necessarily represent a lower quality of exports in comparison with imports but it could represent the mere fact that the commodity imported is more processed than the commodity exported. So when the method is applied to OPT flows a probable outcome is that the FCT calculation via VIIT approach will produce a smaller trade impact in terms of relative demand for skilled labour in comparison with the HO-8 approach. This outcome is the opposite of the result obtained in the case of final flows.

An example can clarify this point. Suppose that 1000 tons of shirts are exported from Italy to Romania in order to be processed and then re-imported in Italy. In HO-8 methodology, the impact on Italian labour market is zero because the same input coefficients (extrapolated from UV^X) are applied to exports and to import substitutes. In VIIT methodology, where different input coefficients are imputed to import substitutes and exports, because $UV^M > UV^X$ we calculate a decrease in labour demand for skilled and unskilled labour and a decline in relative demand for skilled labour in Italy.

In other words, when we apply the VIIT method to OPT flows we have to expect results reflecting simultaneously: 1) quality differentiation, for each 8-digit commodity whose exports and imports are "un-linked" in terms of productive processes; 2) vertical disintegration of production when exports and imports are "linked". It is the OPT-specific effect in point 2 that tend to overestimate the skill-intensity of CEEC production, for the reason above discussed. Clearly this result contrasts with what we should expect when we study the impact of EU-CEEC OPT on EU labour markets, namely an increase in relative demand for skilled labour due to the relocation of less skill-intensive activities to CEECs. In reality the VIIT method implies an underestimation of the impact of OPT on EU labour markets.

A possible adjustment for VIIT method could be the use of UVs of final flows in place of UVs of OPT flows to calculate the labour market impact of OPT. This correction aims to limit the bias above discussed by using UVs of trade flows which are unlinked in terms of production process. A sort of counterfactual assumption is implicit in this correction: suppose to treat OPT flows like final flows, what would be the labour market effect deriving from the pattern of OPT? Obviously, this adjusment is based on the strong hypothesis that there is no vertical disintegration in final flows.

The "t-shirt example" above reported is the case of a commodity exported and reimported in the same 8-digit category. A common circumstance in OPT flows is also the case of a commodity exported and re-imported under a different 8-digit code. In this case, even if there is no quality differentiation at all, the UV of the good reimported will increase as a result of outward processing. In other words, because the good is reimported in a different 8-digit code from the one in which it was exported, so we don't actually identify the fact that $UV^M > UV^X$, but we have still to consider that the effect of outward processing is present in UV^M in any case. Consequently, when we look at this inter-product trade and try to estimate its impact on labour markets, we have to acknowledge that the HO-8 digit method produces biased estimates as well as VIIT method. In the HO-8 digit method UV^X are used to estimate the same input coefficients for exports and import substitutes. But the UV^X of the more processed good reimported (clothing, for example) will be higher than the UV^X of the less processed good exported (textile) only in virtue of the value added. This circumstance will tend to overestimate the skill content of CEECs exports to EU countries. Therefore, we have to be conscious that the method developed in the third chapter in order to measure the impact of intra-industry trade on labour markets produces biased estimates when applied to OPT flows.

Table 5 and table 6 report FCT results obtained for Germany and Italy respectively. Estimates refers to the 8-digit HO method and the VIIT method with/without adjustment. The effect of trade is presented in terms of changes of relative demand for skilled.

Table 5 – Impact of German trade with CEECs on German labour market – 1997[a]

3-digit balanced trade impact

Final flows: skilled = +0.36%, unskilled = -0.58%, relative demand for skilled = **+ 0.94%**
Opt flows: skilled = -1.40%, unskilled = -3.81%, relative demand for skilled = **+ 2.38%**
(+1.58%) [b]

8-digit HO balanced trade impact

Final flows: skilled = +0.16%, unskilled = -0.84% , relative demand for skilled = **+1.00%**
Opt flows: skilled = +1.22%, unskilled = -1.51%, relative demand for skilled = **+2.73%**
(+1.82%) [b]

8-digit with VIIT balanced trade impact
Final flows: skilled = -0.33%, unskilled = -0.78% , relative demand for skilled = **+1.11%**
Opt flows: skilled = +1.18%, unskilled = -1.53%, relative demand for skilled = **+2.71%**
(+1.80%) [b]

8-digit with VIIT balanced trade impact with adjustment [c]
Opt flows: skilled = +1.18%, unskilled = -1.53%, relative demand for skilled = +2.88%
....+(1.92%)

([a]) Trade impact is expressed as percentage of employment
([b]) Factor content of OPT flows scaled down in proportion to the excess of OPT over final flows
([c]) By using UVs of final flows in place of UVs of OPT flows

In the case of Germany, FCT results confirm our expectations based on the structure of trade flows: i) much larger effects in OPT than in final flows because inter-industry trade is bigger in OPT; ii) 3-digit FCT calculation captures the most effect. This result is partially due to the greater magnitude of OPT flows in comparison with final flows (see table 2-A in annex). However when factor content of OPT is scaled down in proportion to the excess of OPT over final flows the stronger HO effects of OPT flows still remain: 1.58% against 0.94% (see results in brackets in table 5).

As we move from the 3-digit to the HO 8-digit calculation, the differential between OPT impact and final flow impact increases (from +153% to +173%, or from 68% to 82% when OPT flows are scaled down proportionally over final flows). This is the fragmentation-driven effect captured by FCT calculation based on inter-product trade.

The inclusion of VIIT effect in 8-digit FCT calculations increases trade impact in the case of final flows but not in the case of OPT flows. This result confirms the idea above reported that the FCT calculation using different coefficients for exports and imports incorporates, in the case of OPT flows, an anti-HO effect for the reason that in OPT $UV^M>UV^X$ on average. But if the 8-digit computation of OPT impact including VIIT effect is carried out by introducing the adjustment above suggested then the impact increases (compare 2.88% against 2.71%)

When we look at Italy (table 6), the results essentially resemble the pattern associated with Germany. At the 3-digit level the labour market effects of OPT are stronger than in the case of final flows (much stronger if the factor content of OPT is scaled up in proportion over the greater dimension of trade in final goods)[59]. The positive differential between the OPT impact and the final flows impact grows when we turn to HO 8-digit FCT calculation. In proportion this increase is bigger than in the case of Germany if the comparison is based on factor content of OPT adjusted to take account of the excess of final flows over OPT. As mentioned before, this outcome corroborates the importance of a disaggregated evaluation in the case of trade impact on Italian labour markets. Finally, when we also consider the impact of VIIT in the 8-digit FCT calculation the effects of OPT on the Italian labour market decrease to a greater degree than in the case of the German labour market. This result is consistent with the previous analysis of the structure of trade flows in which we remarked on the more important share of $VIIT^-$ in

[59]In the Italian case, OPT flows are smaller in comparison with final flows. In 1997 the ratio between OPT flows and final flows is 0.75. See table 5A in annex.

the case of Italian OPT[60]. However, when the UVs of OPT are replaced with the UVs of final flows, the impact of OPT taking account of VIIT effect goes up (compare 0.51% against 0.45%, or 0.72% against 0.64% when factor content of OPT is scaled up in proportion to final flows).

In conclusion, the FCT analysis applied to the case of German and Italian trade with CEECs in the Textile-apparel-footwear-leather sectors suggests that the labour market effects of OPT flows is stronger than the impact of final flows. This result is confirmed both at the 3 and the 8 digit level of aggregation.

Table 6 – Impact of Italian trade with CEECs on Italian labour market – 1997[a]
3-digit balanced trade impact
Final flows: skilled = +0.11%, unskilled = -0.32% , relative demand for skilled = **+0.43%**
Opt flows: skilled = +0.23%, unskilled = -0.27%, relative demand for skilled = **+0.50%** (+0.72%) [b]
8-digit HO balanced trade impact
Final flows: skilled = -0.013%, unskilled = -0.38% , relative demand for skilled = **+0.37%**
Opt flows: skilled = +0.25%, unskilled = -0.28%, relative demand for skilled = **+0.53%** (+0.75%) [b]
8-digit with VIIT balanced trade impact
Final flows: skilled = +0.043%, unskilled = -0.37% , relative demand for skilled = **+0.41%**
Opt flows: skilled = +0.14%, unskilled = -0.31%, relative demand for skilled = **+0.45%** (+0.64%) [b]
8-digit with VIIT balanced trade impact with adjustment [c]
Opt flows: skilled = +0.14%, unskilled = -0.31%, relative demand for skilled = **+0.51%** (+0.72%) [b]
([a]) Trade impact is expressed as percentage of employment ([b]) Factor content of OPT flows scaled up in proportion to the excess of final flows over OPT ([c]) By using the UVs of final flows in place of the UVs of OPT flows

5. Conclusions

In this chapter the impact of OPT between EU countries and CEECs on EU labour markets has been analysed.

A preliminary overview of OPT in EU countries has shown that on aggregate this type of trade still represents a small fraction of total trade. Nevertheless OPT flows display a growth rate much more pronounced in comparison with the dynamics associated with final flows (20% against 7.5% on a yearly basis in the period 1989-1997), confirming the findings mentioned in recent studies of an increasing importance of vertical flows in world trade.

When the sectoral composition of OPT flows is considered, data shows that only three main aggregates account for more than 80% of total manufacturing industry flows: Machinery, Textiles-apparel and Transport. Interestingly, this sectoral concentration of OPT flows links up with a geographical specialisation, indicating a straightforward international division of labour. In particular, OPT flows in Textile-apparel sector are almost entirely channelled to CEECs, Transport OPT flows are mostly directed to North America and OPT flows in machinery are concentrated to Far Eastern countries. Globally, the CEEC area is becoming the main pole of attraction of EU OPT flows, accounting for almost 50% of total OPT. However, when we look at the relevance of OPT flows in comparison with final trade flows at the sectoral and geographical level we can note that

[60] In the Italian case, the possibility of a commodity exported and reimported in the same 8-digit category is more probable than in the German case. This circumstance contributes to reduce the OPT impact on the relative demand for skilled labour. In effect, when we look at disaggregated data at the 8-digit level in order to single out Italian OPT commodities in which $UV^M > UV^X$ we observe that the most part of this kind of flows comprises final goods such as: t-shirts (code 61099030), pullovers (code 61101031), ski-jackets (code 62019300), jackets of wool (code 62033100), trousers (code 62034235), etc.

only in the case of the CEEC area and in Textile-apparel sector is the weight of OPT remarkable.

For this reason we have chosen to evaluate the differential labour market impact of OPT flows with respect to final flows by looking at CEECs in the Textile-apparel-footwear-leather sectors. Given that Germany and Italy account for the main part of EU OPT in CEECs in those sectors, the trade impact has been measured with reference to the labour markets of these two countries. A preliminary analysis of the structure of trade flows has delineated different models for the two countries. In the case of Germany, IIT in OPT is smaller than in final flows; for this reason we expect a greater labour market impact associated with OPT flows. On the contrary, in the case of Italy, IIT in OPT is much more relevant; this suggests that, especially in the Italian case, we also need to conduct FCT analysis at the 8-digit level in order to capture the labour market impact associated with trade flows which are IIT at 3 digit but inter-product trade at 8 digit level.

In accordance with the analysis of the structure of trade flows, FCT analysis applied to the case of German and Italian trade with CEECs in the Textile-apparel-footwear-leather sectors suggests that the labour market effects of OPT flows are stronger than the impact of final flows. This result is confirmed both at the 3 and the 8-digit level of aggregation.

The procedure based on UVs to infer input coefficients at the 8-digit level turns out to be useful in disclosing factor substitution effects due to the vertical disintegration of production in OPT, other than vertical differentiation in final flows.

However, we have remarked that the method developed in the third chapter to estimate the labour market effects of intra-industry trade produces biased estimates when applied to OPT flows in textile, apparel, footwear and leather. This bias is not due to trade in intermediate goods in itself because FCT methodology excludes, from the measure of labour market effects of trade, indirect inputs incorporated in imported intermediates[61]. The bias is due to the overestimation of skill intensity associated with the fact that in these sectors prices of intermediate goods (fabrics) are lower than prices of finished goods (clothing).

But the methodological problems of these sectors do not apply generally, and in principle the FCT methodology developed in this and the previous chapter can apply to trade in intermediates as well as trade in final goods, so long as unit values give unbiased estimates of product quality. Textile, clothing and footwear are unusual in having such a close physical link between the different stages of production. In sector without this unusual feature, unit values might be taken as a fairer guide to quality. In retrospect, the choice of sectors for this study was problematic and it would be highly desirable to repeat the study in other sectors.

Nevertheless, the calculation of labour market impact of IIT carried out in this work is based on a quite fragile inference whose robustness must be tested and the whole exercise suffers from the limitations of a crude FCT calculation with no price factor adjustment and other more sophisticated general equilibrium effects. Nevertheless the approach presented in this chapter is a pioneering way to deal with the issue of aggregation and heterogeneity in trade; it suggests that any accurate study of the labour market effect of trade should consider the importance of this aspect.

[61] Trade in intermediates between advanced and less developed countries raises the question whether the employment effects of trade has to be measured just in terms of value added. In general, a relevant part of the increase of developing countries exports in manufactures is due to the filling-in of gaps left free by a gradual process of "negative import substitution" in the developed economies. In the transfer of production (and of export) quotas to the developing economies, the import content does not remain unchanged; it is possible that it increase owing to the incompleteness of the inter-industrial matrix of developing countries (Ginzburg, 1984, pag. 26).

Annex

German tables

Table 1-A

Sectoral composition and geographical distribution of Germany OPT flows. 1989-1997.

Percentage shares

	1989						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	54%	8%	14%	78%	0%	0%	100%
Mec-Elect	26%	1%	73%	7%	18%	0%	100%
Transport	1%	27%	14%	39%	19%	0%	100%
Others	19%	2%	11%	73%	15%	0%	100%
Total Manuf	100%	4%	36%	49%	10%	0%	100%
	1997						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	48%	7%	5%	87%	0%	0%	100%
Mec-Elect	31%	1%	56%	33%	9%	0%	100%
Transport	7%	0%	1%	14%	85%	0%	100%
Others	14%	1%	11%	72%	17%	0%	100%
Total Manuf	100%	4%	24%	59%	13%	0%	100%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Table 2-A

OPT flows/final flows ratio. Germany

(Imports+Exports, thousand of ECUs)

	1989					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	17%	8%	4%	276%	0%	0%
Mec-Elect	2%	0%	9%	5%	2%	0%
Transport	0%	0%	0%	2%	0%	0%
Total 3	4%	2%	7%	41%	1%	0%
Total Manuf	2%	1%	4%	25%	1%	0%
	1997					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	34%	26%	5%	172%	1%	3%
Mec-Elect	4%	1%	9%	9%	2%	0%
Transport	3%	0%	0%	2%	16%	0%
Total 3	8%	6%	7%	24%	5%	0%
Total Manuf	5%	4%	5%	15%	3%	0%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Table 3-A

Germany shares of EU OPT flows

(Imports+Exports, thousand of ECUs)

Sectors*	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
1989						
Text-appar	69%	15%	82%	68%	21%	5%
Mec-Elect	27%	11%	47%	67%	11%	2%
Transport	4%	44%	72%	12%	1%	0%
Others	42%	6%	54%	74%	16%	16%
Total Manuf	42%	14%	51%	68%	11%	2%
1997						
Text-appar	57%	35%	53%	59%	26%	58%
Mec-Elect	36%	20%	44%	66%	16%	3%
Transport	37%	3%	38%	85%	45%	1%
Others	40%	9%	48%	60%	25%	2%
Total Manuf	45%	28%	44%	61%	28%	6%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Italian tables

Table 4-A

Sectoral composition and geographical distribution of Italy OPT flows. 1989-1997.

Percentage shares

Sectors*	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
1989							
Text-appar	4%	7%	40%	53%	0%	0%	100%
Mec-Elect	56%	4%	67%	1%	27%	1%	100%
Transport	31%	4%	0%	0%	95%	1%	100%
Others	8%	5%	4%	10%	76%	4%	100%
Total Manuf	100%	4%	43%	5%	47%	1%	100%
1997							
Text-appar	43%	5%	4%	90%	0%	1%	100%
Mec-Elect	18%	5%	33%	10%	49%	3%	100%
Transport	12%	1%	1%	8%	87%	3%	100%
Others	27%	1%	5%	82%	9%	2%	100%
Total Manuf	100%	4%	10%	68%	17%	2%	100%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Table 5-A

OPT flows/final flows ratio. Italy

(Imports+Exports, thousand of ECUs)

	1989					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	1%	0%	1%	6%	0%	0%
Mec-Elect	3%	0%	5%	0%	1%	0%
Transport	7%	1%	0%	0%	8%	0%
Total 3	3%	1%	3%	2%	2%	0%
Total Manuf	1%	0%	2%	1%	1%	0%
	1997					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	8%	3%	1%	75%	0%	1%
Mec-Elect	1%	1%	2%	1%	3%	0%
Transport	4%	0%	0%	1%	8%	0%
Total 3	4%	1%	1%	16%	3%	0%
Total Manuf	2%	1%	1%	12%	1%	0%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Table 6-A

Italy shares of EU OPT flows

(Imports+Exports, thousand of ECUs)

	1989					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	1%	0%	6%	1%	5%	0%
Mec-Elect	14%	10%	9%	1%	4%	1%
Transport	43%	34%	13%	0%	27%	65%
Others	4%	2%	2%	1%	7%	17%
Total Manuf	10%	2%	9%	1%	7%	2%
	1997					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	12%	5%	9%	14%	5%	36%
Mec-Elect	5%	8%	2%	2%	8%	6%
Transport	15%	5%	6%	6%	6%	24%
Others	18%	4%	7%	23%	5%	31%
Total Manuf	10%	5%	3%	13%	7%	12%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

French tables

Table 7-A

Sectoral composition and geographical distribution of France OPT flows. 1989-1997.

Percentage shares

	1989						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	28%	73%	1%	26%	0%	0%	100%
Mec-Elect	37%	12%	27%	2%	35%	24%	100%
Transport	9%	1%	0%	1%	98%	0%	100%
Others	26%	42%	7%	16%	34%	1%	100%
Total Manuf	100%	36%	12%	12%	29%	10%	100%
	1997						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	20%	39%	1%	59%	0%	0%	100%
Mec-Elect	49%	7%	62%	6%	18%	7%	100%
Transport	14%	3%	1%	1%	93%	2%	100%
Others	17%	33%	9%	12%	46%	0%	100%
Total Manuf	100%	17%	37%	17%	25%	4%	100%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Table 8-A

OPT flows/final flows ratio. France

(Imports+Exports, thousand of ECUs)

	1989					
				Areas		
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	8%	26%	1%	114%	0%	0%
Mec-Elect	3%	2%	5%	6%	4%	19%
Transport	2%	0%	0%	2%	8%	0%
Total 3	4%	7%	3%	37%	5%	12%
Total Manuf	2%	5%	2%	19%	3%	6%
	1997					
				Areas		
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	9%	10%	0%	114%	0%	0%
Mec-Elect	6%	4%	13%	6%	4%	9%
Transport	3%	0%	0%	0%	7%	1%
Total 3	6%	4%	10%	17%	5%	5%
Total Manuf	4%	4%	6%	10%	3%	3%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Table 9-A

France shares of EU OPT flows

(Imports+Exports, thousand of ECUs)

	1989					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	15%	62%	4%	10%	22%	17%
Mec-Elect	16%	77%	10%	12%	13%	88%
Transport	21%	12%	14%	2%	43%	14%
Others	24%	81%	18%	9%	20%	40%
Total Manuf	17%	66%	10%	10%	18%	84%
	1997					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	8%	32%	2%	7%	3%	0%
Mec-Elect	20%	64%	25%	6%	16%	75%
Transport	25%	23%	16%	2%	18%	39%
Others	17%	81%	12%	3%	20%	3%
Total Manuf	15%	43%	22%	6%	18%	58%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Dutch tables

Table 10-A

Sectoral composition and geographical distribution of Netherland OPT flows. 1989-1997.

Percentage shares

	1989						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	18%	35%	3%	61%	0%	0%	100%
Mec-Elect	74%	0%	20%	0%	78%	1%	100%
Transport	2%	0%	0%	1%	99%	0%	100%
Others	6%	3%	2%	11%	82%	3%	100%
Total Manuf	100%	4%	17%	8%	70%	1%	100%
	1997						
		Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**	Tot Areas
Sectors*							
Text-appar	30%	22%	2%	75%	2%	0%	100%
Mec-Elect	61%	1%	66%	4%	29%	1%	100%
Transport	2%	4%	5%	8%	69%	14%	100%
Others	7%	5%	11%	24%	48%	10%	100%
Total Manuf	100%	8%	41%	27%	23%	2%	100%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Table 11-A

OPT flows/final flows ratio. Netherlands

(Imports+Exports, thousand of ECUs)

	1989					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	15%	49%	1%	188%	0%	2%
Mec-Elect	15%	1%	20%	2%	43%	17%
Transport	1%	0%	0%	1%	2%	0%
Total 3	12%	14%	11%	52%	29%	11%
Total Manuf	6%	4%	6%	22%	15%	2%
	1997					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	15%	26%	0%	119%	2%	0%
Mec-Elect	5%	1%	7%	3%	4%	2%
Transport	1%	1%	0%	1%	2%	4%
Total 3	6%	10%	5%	20%	3%	2%
Total Manuf	3%	5%	3%	10%	2%	1%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Table 12-A

Netherlands shares of EU OPT flows

(Imports+Exports, thousand of ECUs)

	1989					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	8%	9%	3%	8%	7%	22%
Mec-Elect	27%	1%	15%	3%	55%	9%
Transport	5%	0%	0%	0%	6%	0%
Others	4%	1%	2%	2%	14%	22%
Total Manuf	15%	7%	13%	6%	41%	10%
	1997					
	Areas					
	Extra-EU	Africa	Asia**	CEEC**	North Ame	South Ame**
Sectors*						
Text-appar	6%	11%	2%	5%	42%	0%
Mec-Elect	12%	3%	11%	2%	11%	4%
Transport	2%	3%	8%	2%	1%	33%
Others	3%	3%	4%	1%	5%	28%
Total Manuf	7%	8%	10%	4%	7%	9%

(*) Text-appar: 50-63; Mec-Elect: 84-85; Transport: 86-89; Total manuf: 28-99
(**) Selected countries

Source: Comext

Chapter 5: Conclusions

1. The disaggregated approach

In this work I have proposed a disaggregated approach in order to deal with two important issues in the area of international trade studies: the determinants of intra-industry trade and the labour market effects of international trade. Fundamentally, my approach is a development of the recent literature on intra-industry trade stressing the importance of separating vertical from horizontal components in IIT. The implication of this distinction is important because this separation allows the explanation of IIT according to Heckscher-Ohlin principles. The possibility of identifying VIIT in trade data offers the opportunity of evaluating the role of product heterogeneity and this opens new opportunities in empirical analysis.

The second chapter has shown that a careful consideration of the aggregation issue allows identification of the appropriate level of disaggregation consistent with the specific phenomenon which we want to observe. For example, we have recognize that the 8-digit level of disaggregation is ideal to observe product differentiation by quality but not by attribute. Furthermore, the division of VIIT in up-market and down market components helps to meet the predictions of factor proportion theory.

In the third chapter, the same disaggregated approach has been useful to provide a new treatment of the labour market effects of international trade. The exploration conducted in the third and fourth chapters has clearly showed that the analysis confined to the sectoral level of the labour market adjustment to international trade risks hiding important factor substitution effects acting within-industry. Obviously, we have also recognized the limits associated with the use of statistical inference in order to estimate industry variables, like input coefficients, at the most disaggregated level. There is a big gap between trade data and industry data: the deep level of disaggregation available for the first is not matched for the second. This forces us to rely on heroic statistical inferences whose robustness has to be tested extensively (in terms of different countries, years, trading partners). Although the limits of statistical inference are evident and call for a systematic census of industry variables within sectors, the disaggregated approach followed in this thesis produce results which are plausible and strongly suggestive of further developments.

2. The explanation of intra-industry trade

As observed in the introductory chapter, the econometric analysis of the determinants of intra-industry trade has produced more robust results when country-specific effects are investigated. These effects concern the level of development of the economies, their size, the degree of taste overlap between trading partners, their common participation to institutional agreements promoting economic integration (like in Europe), etc.

When industry-specific effects are explored, econometric results are less robust because on the one hand it is intrinsically difficult to find appropriate proxies for market structure variables, and on the other hand the plurality of theoretical models explaining intra-industry trade makes problematical the elaboration of a comprehensive econometric specification producing unambiguous results.

However, in recent years, interesting developments in the analysis of intra-industry trade has improved the econometric testing of industry-specific determinants of the phenomenon by looking separately at vertical and horizontal components of IIT. This distinction is crucial because theoretical models have offered different explanations for the two forms of IIT.

In this regard, the methodological and empirical investigation of Greenaway, Hine and Milner is important. They have divided VIIT from HIIT in trade data and have separately tested the two components of intra-industry trade. Their econometric results, in a case study of the UK intra-industry trade, have demonstrated that this separation is worth pursuing, leading to a better understanding of the phenomenon.

The analysis presented in the second chapter locates in the area of the empirical research on the industry-specific determinants of VIIT and HIIT. Focussing on the UK intra-industry trade, my contribution tried to develop the seminal work of Greenaway, Hine and Milner by introducing two innovations: i) a deeper degree of disaggregation of trade data in order to provide a more reliable measure of quality differentiation of traded goods; ii) a separate testing of up-market and down-market components of vertical intra-industry trade in order to improve the specification of the link between factor proportion explanatory variables and vertical intra-industry trade, according to Heckscher-Ohlin principles.

Econometric results demonstrated that my innovations were worthwhile, although some limitations have emerged.

First of all, the adoption of a deeper level of disaggregation (the 8-digit versus the 5-digit level adopted by Greenaway, Hine and Milner) seems to be the correct way to approach the phenomenon of vertical intra-industry trade because one can have more confidence that unit value differences authentically reflect quality differentiation in otherwise similar products. But, at the same time, the disaggregation at the product level (8-digit) risks to lose a significant amount of HIIT because information about attribute differentiation is lost. The level of disaggregation adopted in my analysis could potentially explain why my estimates for HIIT were so unsatisfactory.

I have obtained better estimates for vertical intra-industry trade, confirming that the adoption of the 8-digit level of disaggregation is appropriate in order to observe quality differentiation. Explanatory variables relating to market structure and factor proportion were significant and seem to support the large numbers model of vertical intra-industry trade. In particular, some regressors (like capital intensity) were significant for all version of VIIT, while other regressors (like skill intensity or the number of firms) were significant only when vertical intra-industry trade is divided in up-market and down-market components. This result shows the importance of separating $VIIT^+$ from $VIIT^-$.

However, the results signal that the cross-sectoral role played by factor intensity in the explanation of vertical intra-industry trade does not support an HO view. Even my innovation of testing up-market and down-market components of VIIT separately, in order to capture the link between factor intensity and comparative advantages in vertical intra-industry, has not performed as I expected. Retrospectively I have recognized that it is intrinsically difficult to predict VIIT using cross-sectoral data, because VIIT is an intra-sectoral phenomenon arising from variance in quality within sector. A good prediction of VIIT across sectors would be a variable which indicated *variance* in quality, but industry data within sector are not available. So we have to try to infer from the regression results the characteristics of sectors which have high quality variance (via VIIT).

Nevertheless, I am confident that potentially my solution of separating $VIIT^+$ from $VIIT^-$ can improve the interpretation of econometric results in terms of HO explanation of VIIT (even if I am conscious that this innovation is a partial solution). Let me recall the reason for that. As discussed in the second chapter, if a country has a comparative advantage in skill-intensive products in trade with countries compared to which it is well endowed with human capital, we should expect to see different forms of VIIT in different sectors. In other words, the theory provides justifications for the dissection of VIIT *within* sectors rather than the distribution of VIIT across sectors. If, for example, the UK is well-endowed with skill and if high quality goods are more skill-intensive than low-quality goods, then we would expect the UK to have a comparative advantage in skill-intensive sectors *and within* these sectors to be a net exporter of high quality goods, and we would observe an association across sectors between 'up-market' VIIT and the skill-intensity of production.

The implications of my results in terms of future research agenda are strictly connected with the discussion reported above.

First of all, it would be useful to test the determinants of HIIT and VIIIT by adopting alternative levels of disaggregation of trade data. A systematic exploration of the sensitivity of results to the change of aggregation/disaggregation degree in trade data could be useful to calibrate the methodology in terms of expected results. For example, an attempt to improve my estimate for HIIT could consist in the adoption of a slightly less deep level of disaggregation in calculation of GL indices in order to make visible attribute differentiation of traded goods.

Secondly, my work could be improved by having more accuracy in representing HO trade. My idea is to replicate in the short run the same testing on UK VIIT and HIIT determinants, by assuming a different geographical differentiation of trading partners: the group of advanced countries and the area of non-advanced countries. This analysis could provide a more appropriate context to test the validity of separating $VIIT^{+}$ from $VIIT^{-}$ according to HO principles. However, in the future, industry-specific and country-specific factors should be integrated in the analysis of VIIT and HIIT, according the lines experimented by Balassa and Bauwens (1987). The Panel data analysis would be desirable, but was beyond the scope of this thesis.

Finally, it would be desirable to improve the interpretation and the robustness of results associated with the analysis of VIIT and HIIT, by testing the components of IIT on the basis of trade data in which final goods are separated from intermediate goods (on this regard, statistics on OPT could be employed).

3. The impact of trade on labour markets

While in the second chapter I investigated the effects of factor proportion on intra-industry trade, in the third chapter I examined the adjustment of factor markets to intra-industry trade. In particular, I carried out an empirical analysis of the labour market effects of international trade built on a model of VIIT which is based on Heckscher-Ohlin principles.

The evaluation of the impact of globalisation on labour markets of advanced countries is still an open issue. Although in the last twenty years stylised facts have supported a strong association between the growing penetration of newly industrialized countries in OECD markets and the adverse shift in labour demand for unskilled workers in advanced countries, the majority of academic opinion does not believe in that association. Apparently, the standard model of international trade, the HOS model, provides a solid support to the link between trade and income distribution: international trade between economies with different endowments of human skills decreases the relative remuneration of the scarce factor, which in more developed countries is unskilled labour. But when all implications of the model are compared with the empirical evidence, some discrepancies emerge. The link between good prices and factor prices and the inverse relationship between relative remuneration and factor ratios, which are crucial in the chain of causation postulated by HOS model (or SS theorem), are not corroborated by empirical data. For this reason, especially trade theorists have dismissed the trade-based explanation of inequality, even though FCT studies have provided a quite substantial support to the impact of trade on labour markets of advanced countries. On this regard, the heterodox FCT analysis of Adrian Wood built on the notion of non-competing imports is a relevant contribution which warns against the risk of understating the effects of trade on labour markets if product heterogeneity is not considered adequately.

Alasdair Smith has argued that the real issue is that the standard sectoral analysis adopted in trade models fails to provide an adequate treatment of skill-intensity and of IIT as a trade in products that are not identical in their method of production. Analyses limited to a sectoral level of disaggregation could hide substantial differences in skill requirements within sector and a relevant amount of inter-product trade and vertical intra-product trade. In the end, these considerations lead to the message of Wood: if we do not consider heterogeneity within sector, we risk to underestimate the impact of trade on labour markets inevitably.

Following the important methodological indications of Wood and Smith, the work reported in third chapter provided a new treatment of the labour market effects of international trade. The main contribution of the work was essentially a FCT analysis modified to capture labour market effects acting within sector in terms of factor substitution induced by inter-product trade and vertical intra-product trade; these two forms of trade can be included in Wood's notion of non-competing trade.

The analysis was built on a model of vertical intra-industry trade which is more consistent with stylised facts about North-South trade than the traditional Heckscher-Ohlin model of inter-industry trade. In this model each sector is modelled as containing a continuum of techniques, with two factors, manual and non-manual labour proxying for unskilled and skilled labour. This permits factor substitution within sectors at the level of the individual product, with skill intensity positively related to quality. In this framework, skill-abundant countries move along the quality spectrum in each sector with respect to less abundant countries, the result being intra-industry specialization with labour market effects. The properties of the model are consistent with the three stylised facts which are emphasized in the literature on trade and labour markets to dismiss the Stolper-Samuelson explanation of inequality: i) the absence of a clear intersectoral link between skill premium and relative prices; ii) an increase of the skilled/unskilled ratio in all sectors; iii) no systematic change in the intersectoral composition of production.

I applied this model to the case of Italian trade with less advanced countries. The implications of vertical IIT for labour markets is particularly pertinent to the case of an advanced country like Italy, whose international specialization is strongly oriented towards traditional consumption goods; this peculiarity of Italian economy increases the risk of underestimating the labour market effects of trade with less advanced countries if quality differentiation is not considered adequately.

The first step of the empirical work was the identification of the share of trade flows which could have a substantial impact on labour markets. The calculation of Grubel-Lloyd indices of IIT at the 8-digit level has revealed a quite relevant amount of trade flows which are IIT at the 3-digit level but HO trade at the product level: this inter-product trade amounts to 22%. In addition, the calculation of VIIT index has showed that another non trivial share of trade could implies factor substitution on labour markets: these intra-product flows differentiated by quality total 16%. In the end, the analysis conducted via IIT indices showed that only 5% of total Italian trade with LACs in manufactures has no impact on labour markets (this share consists of horizontal intra-product trade). This evidence is straightforward and suggests that if we were able to carry out a FCT calculation at the product level, we will find a more substantial impact of trade on labour markets in comparison with a standard FCT analysis conducted at sectoral level.

In the second step of empirical work I tried to implement a methodology able to carry out the FCT calculation at the 8-digit level. Obviously, this sort of calculation is a very hard task because industry data disaggregated at the product level is not available. So had to derive input coefficients at the product level from industry data at the 3-digit level and trade data at the 8-digit level using the inter-sectoral relationship between factor intensity and average unit values of exports. As expected, the estimated impact of trade was bigger when the FCT calculation was conducted at the product level: the 8-digit calculation produced an impact more than 30% larger than the 3-digit calculation. The impact is even more significant when vertical intra-industry is included in the FCT calculation (nearly 40% bigger).

These numbers are not trivial and suggests that intra-industry trade can have a substantial additional impact on labour markets. The implications of this evidence in terms of research strategy are important because, whatever trade model adopted, the level of aggregation matters and the analysis of the labour market consequences of globalisation cannot neglect the role of intra-industry trade, because the magnitude of the impact associated with IIT turn out to be quite substantial. Beyond the estimates produced by my FCT calculation at the 8-digit level, even the simple observation of IIT, VIIT, HIIT indices at the product level signals that, when we assume sectors and not products as units of analysis, we lose a relevant amount of trade flows which potentially could induce factor substitution.

In effect, my estimates are rather crude and based on a quite fragile statistical association between factor intensity and unit values across sectors. As shown in the third chapter, sensitivity analysis of results is not completely satisfactory.

However, I think that the best sensitivity analysis of results deriving from my methodology could be carried out by replicating the study for other countries, other sectors and other periods.

In the agenda for future research, after testing the robustness of methodology presented in the third chapter by providing more empirical evidence, a possible development of the approach presented here could be a refinement of the analysis within a CGE framework in order to evaluate the additional impact of IIT when a larger range of effects is explored.

Another important improvement of the analysis should be implemented in terms of a better definition of skill-intensity. The division between manual and non-manual workers is a poor characterization of labour skills, not much better than the distinction adopted in American work on this issue (production and non-production workers). A richer treatment of skills, for example a composite index of labour skill including level of education, labour experience, career degree, etc. would be desirable.

Product differentiation matters but also regional differentiation is important. In fact, the national dimension of the analysis could hide important labour market effects of trade which operate at the regional level. Celi and Segnana (2000) have demonstrated that the dualistic character of Italy’s industrial structure makes it necessary the use of labour market and trade data disaggregated by location. In effect, the application of the factor content of trade methodology on regional basis has showed that the impact of Italian trade with LACs is regionally differentiated, with a trade-induced displacement effects on demand for unskilled labour more marked in Northern Italy than in Southern Italy. A systematic work extended to other countries about the role of regional differentiation in labour market effects of trade would also be desirable.

4. Fragmentation

The fourth chapter of this work has investigated the impact of trade on labour markets in the presence of international fragmentation of production. In recent years many studies have remarked that an important aspect of globalisation is the growing disintegration of production on a international scale. A relevant amount of trade flows is activated from processes of relocation of production. These recent developments in the composition of world trade flows have induced a rethinking of the traditional patterns of comparative advantages and influential trade theorists have started to model fragmentation.

Obviously, these new developments in the internationalisation of world economy have implications for the link between trade and labour markets and, inevitably, they contribute to the shape of the debate on trade and jobs. In the literature, the majority of academic opinion assigns to international trade the role of generating between-industry effects and to technological change the role of producing within-industry effect. In the third chapter, I have provided evidence that international trade could generate within-industry effects in the presence of product heterogeneity (via inter-product trade and vertical intra-product trade). Now, another reason could explain within-industry effects of trade: the presence of vertical disintegration in trade flows. Feenstra has clarified very well how trade flows activated by international relocation of production could have the same within-industry effects as skill-biased technological change in the form of unskilled-adverse shifts in labour demand. Consequently, the analysis of labour market effects of trade in the presence of vertical disintegration in trade flows cannot be limited to the observation of inter-sectoral trade.

In the fourth chapter, I utilized the same disaggregated approach adopted in the third chapter in order to analyse the impact of EU-CEEC OPT trade in textile-clothing sectors on labour markets of EU countries. This study turned out to be appealing for two reasons: i) it allowed testing of the methodology developed in third chapter in a different context, in which all trade consists of intermediate inputs; ii) it contributed to the general reflection about the consequences for Western EU countries of the impending EU enlargement to Central Eastern European countries.

Firstly, the fourth chapter provided a general description of OPT flows showing that they have grown sharply in the last decade. The reason explaining this substantial increase of OPT flows is two fold: on the one hand a favourable trade regime has induced many EU firms to turn subcontracting from a national to an international dimension; on the other hand, the statistical regime instituted in order to collect OPT data has made visible part of a preexistent phenomenon. Surely, OPT data underestimate the magnitude of international fragmentation processes. Nevertheless, they are very significant in terms of the dynamics of the phenomenon and confirm the increasing importance of vertical flows in world trade, as mentioned in recent studies. In the description of the phenomenon, I observed a strong international division of labour with the concentration of OPT in few sectors and few geographica areas. For example, OPT flows in the textile-apparel sector are almost entirely channelled to CEECs.

Secondly, the fourth chapter tried to evaluate the impact of OPT trade in textile-clothing-footwear-leather sectors on labour markets of two EU countries, Germany and Italy. The choice of these two countries was motivated for their importance in total EU-CEEC OPT flows and for the difference in their models of outsourcing towards CEECs. The choice of textile-clothing-footwear-leather sectors allowed to focus on industries where EU-CEEC OPT flows are of comparable size to final flows.

The factor content of trade analysis showed that OPT flows produce a more substantial impact on labour markets of EU countries than the effects produced by final flows. A bigger change in relative demand for skilled labour was associated with OPT flows, whether the FCT calculation was conducted at the sectoral level at the product level.

Nevertheless, the use of UVs in order to estimate skill-intensity at the product level turned out to be problematic for OPT flows in textile and clothing. When the 8-digit FCT method developed in third chapter is applied to OPT, the circumstance that $UV^M > UV^X$ – just because the good imported is more processed than the good exported - generates biased estimates of the trade impact on labour markets, in terms of an overestimation of the skill content incorporated in CEEC exports to the EU. However, we remarked that this bias associated to 8-digit FCT methodology applied to intermediate trade flows has not to be exaggerated because the circumstance that $UV^M > UV^X$ is specific to OPT in textile and clothing and it is not representative of the general case.

Results obtained in the fourth chapter have been useful to test the FCT methodology poposed in the third chapter by looking at a different type of trade flows. However, in the agenda of future research, an application of the same methodogy to different sectors involved in OPT would be desirable.

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